Barnett Shale Natural Gas Production and Air Quality

By Ed Ireland, Ph.D.

A study on air emissions from Barnett Shale natural gas production activities was recently released by an engineering professor, Dr. Professor Al Armendariz at Southern Methodist University. Entitled "Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements", the study was commissioned by the Environmental Defense Fund, a New York City-based environmental group. The study was released in the Austin offices of State Representative Lon Burnam, D-Fort Worth, who serves on the Environmental Regulation Committee.

The EDF study focuses on the 9-county Dallas-Ft. Worth ozone non-attainment area (DFW NAA) as designated by the Environmental Protection Agency which includes Tarrant, Denton, Parker, Johnson, Ellis, Collin, Dallas, Rockwall and Kaufman counties. However, the study refers to emissions for the entire 21-county Barnett Shale region. The EDF study attempts to estimate emissions of the pollutants nitrogen oxides (NOx), volatile organic compounds (VOC), hazardous air pollutants (HAPs), and of the greenhouse gases methane (CH4) and carbon dioxide (CO2). Estimating emissions of NOx and VOC is important because these pollutants can contribute to the creation of ozone during certain weather conditions. High ozone levels in the DFW area are responsible for the area being designated a "non-attainment" area by the Environmental Protection Agency.

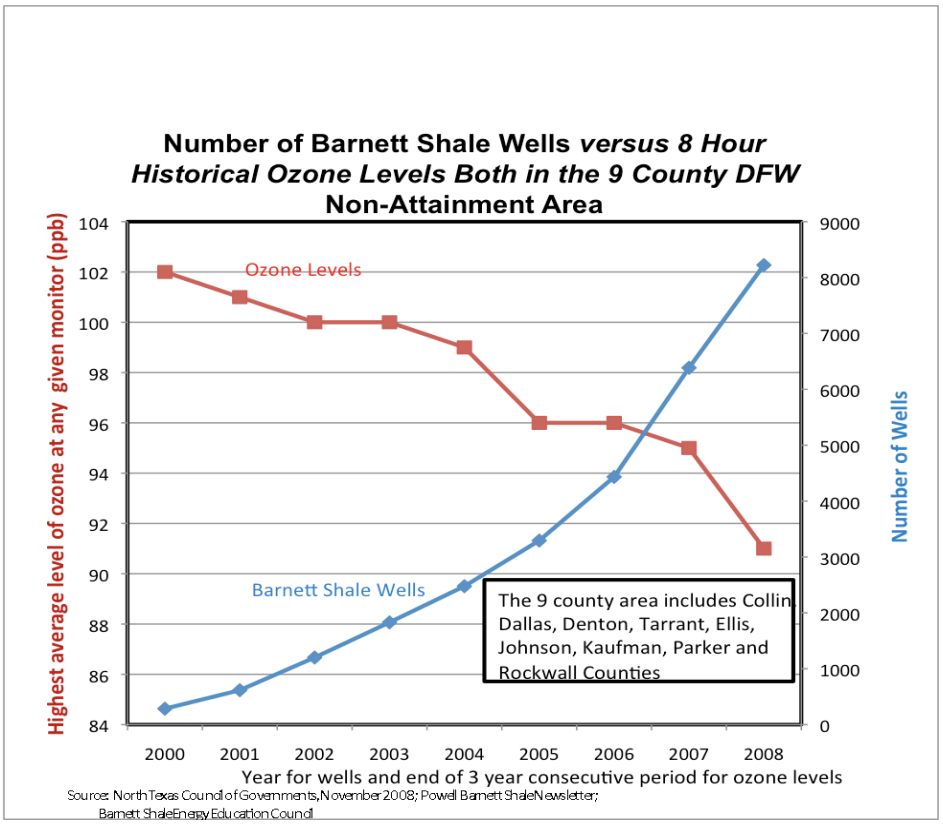
The primary result from the EDF study was a comparison of the amount of pollutants which come from natural gas production activities in a 21-county area to that which is generated from on-road mobile sources and airports in the 9-county DFW NAA.

After 35 pages of analysis, the EDF study offers the following conclusions:

> "Emissions of ozone and fine particle smog forming compounds (NOx and VOC) will be approximately 191 tons per day on an annual average basis in 2009. During the summer, VOC emissions will increase, raising the NOx + VOC total to 307 tons per day, greater than the combined emissions from the major airports and on-road motor vehicles in the D-FW metropolitan area."

Keep in mind that the EDF study is comparing the air emissions from cars and trucks to the air emissions from the natural gas production activities themselves, not to air emissions as the natural gas is burned in homes or by other industries. The study asserts that: "All categories in the Barnett Shale contributed to VOC emissions, but the largest group of VOC sources was condensate tank vents." If natural gas production activities are responsible for the creation of more ozone than all the cars and trucks in north Texas, as implied in the EDF study, that is a significant finding. Therefore, such an implication deserves close scrutiny.

A simple test of the EDF study's implication is to compare measurements of air quality in the area to the number of Barnett Shale wells that have been drilled. If the EDF study's implication is correct, then given the exponential rise in the number of Barnett Shale wells, ozone levels in the region should have increased or at least remained steady in spite of the emissions reductions accomplished in the 9-county DFW NAA over the last several years.

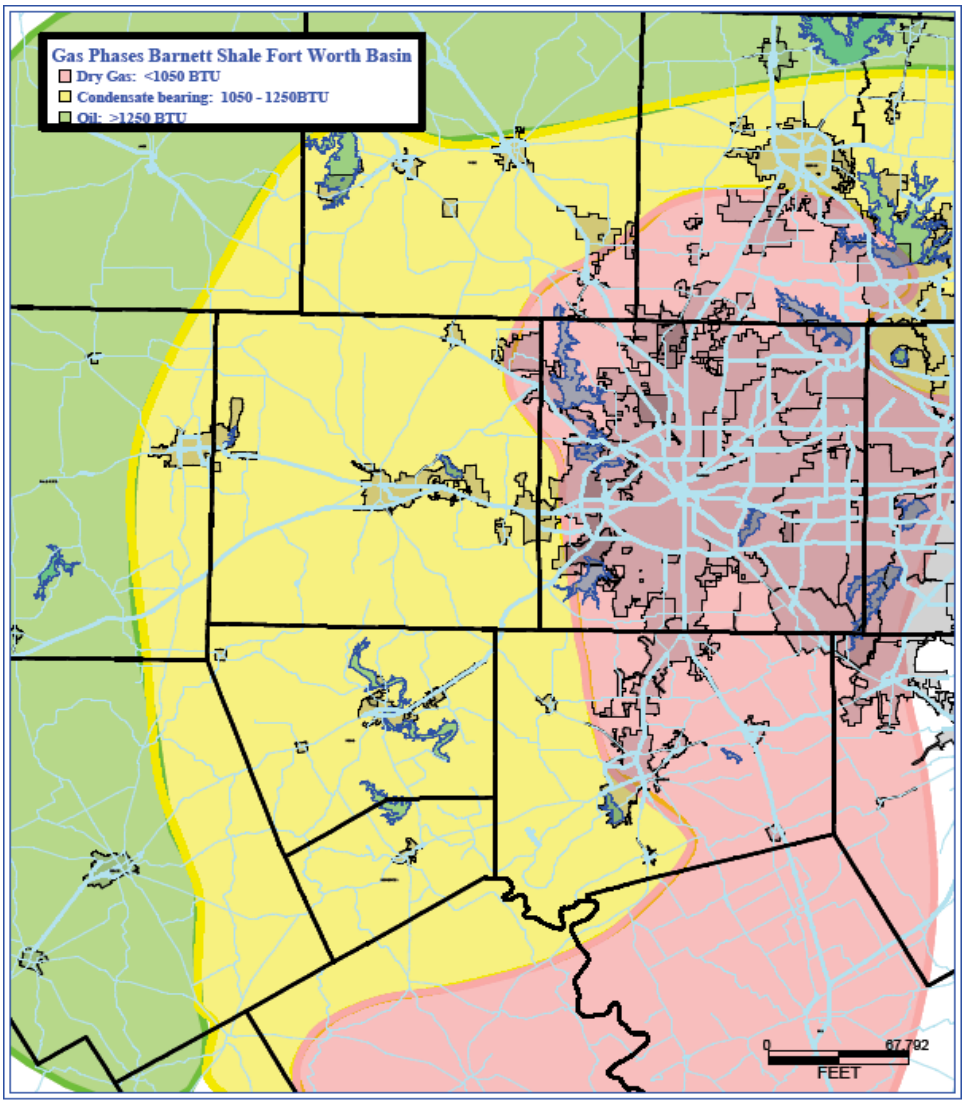


Instead, the graph shows that as more and more Barnett Shale wells have been drilled, ozone levels in the area have decreased (as well they should given the emissions reductions accomplished in the 9-county DFW NAA). This data suggests that there is no clear relationship between Barnett Shale natural gas production activities and the highest average ozone levels.

So why is there no clear relationship between the number of natural gas wells and highest average ozone levels, contrary to the implications in the EDF study? There are several primary reasons.

First, most of the natural gas produced in and around the 9-county DFW NAA is very "dry" gas. The reason, geophysicists say, is that this part of the Barnett Shale is "thermally mature", meaning that these natural gas wells produce no associated oil or other liquids. This means that the vast majority of Barnett Shale wells in the 9-county DFW NAA do not require tanks for condensate storage. Little or no VOC is emitted from these gas wells. The following map shows the

approximate boundary areas of “dry” gas (pink), “richer” gas with condensate production (yellow), and even “richer” gas with oil production (green) in the Barnett Shale.



Individual well data from the Texas Railroad Commission shown in the table below also demonstrates this fact.

9-County EPA DFW Non-Attainment Area Barnett Shale Wells in November, 2008				
County	No. of Zero Condensate Wells	No. of Measureable Condensate Wells	Total Wells	% Zero Condensate Wells
COLLIN	0	0	0	100
DALLAS	8	0	8	100
DENTON	1,838	696	2,534	72.5
ELLIS	29	0	29	100
JOHNSON	2,290	110	2,400	95.4
KAUFMAN	0	0	0	100
PARKER	585	511	1,096	53.4
ROCKWALL	0	0	0	100
TARRANT	1,970	99	2,069	95.2
9-County Area	6,720	1,416	8,136	82.6

Sources: Railroad Commission of Texas; Powell Barnett Shale Newsletter.

The results are the same if we look at all oil and gas wells in the Barnett Shale area, not just wells that produce only from the Barnett Shale. The table below shows that 82.9 percent of all gas wells in the 9-county DFW NAA produce zero condensate.

9-County EPA DFW Non-Attainment Area ALL Wells in November, 2008				
County	No. of Zero Condensate Wells	No. of Measureable Condensate Wells	Total Wells	% Zero Condensate Wells
COLLIN	0	0	0	100
DALLAS	8	0	8	100
DENTON	2,080	900	2,980	69.8
ELLIS	29	0	29	100
JOHNSON	2,290	110	2,400	95.4
KAUFMAN	0	0	0	100
PARKER	2,920	825	3,745	78.0
ROCKWALL	0	0	0	100
TARRANT	2,051	102	2,153	95.3
9-County Area	9,378	1,937	11,315	82.9

Sources: Railroad Commission of Texas; Powell Barnett Shale Newsletter.

In fact, approximately 65% of the condensate produced in the 21-county Barnett Shale region is produced in counties west of the DFW NAA. Also, of the condensate that is produced in the DFW NAA (the other 35%) most is produced in the western and northwestern edge of the DFW NAA in Denton and Parker counties.

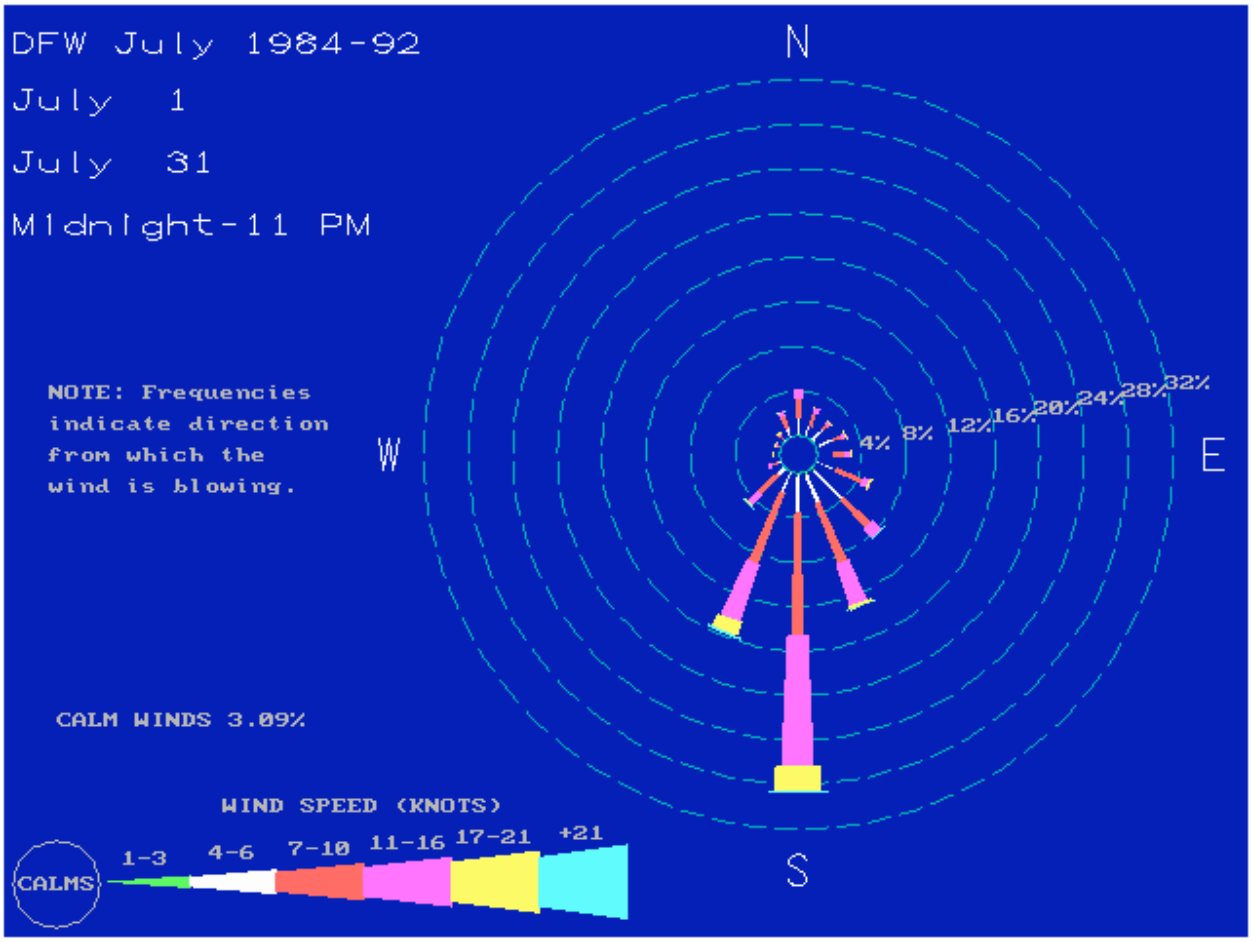
Second, a basic flaw in the EDF study is that it assumes that wells in the 21 county Barnett Shale area that do produce condensate all have the same amount of VOC emissions per barrel of condensate produced, regardless of the production pressure of the wells or other site specific variables. The study noted:

> "Condensate and oil tanks can be significant emitters of VOC, methane and HAPs. A study was published by URS Corporation which presented the results of a large investigation of emissions from condensate and oil tanks in Texas. Tanks were sampled from 33 locations across East Texas, including locations in the Barnett Shale area. Condensate tanks in the Barnett Shale were sampled in Denton and Parker Counties, and oil tanks were sampled in Montague County. The results from the URS investigation were used in this study to calculate Barnett Shale-specific emission factors for VOC, CH4, HAPs, and CO2, instead of using a more general Texas-wide factor."

From an engineering standpoint, it is simply wrong to apply one VOC emissions factor to all condensate storage tanks located in the 21 county Barnett Shale area and expect a reliable estimate of emissions. This is because well producing pressure greatly affects potential VOC emissions from a condensate storage tank. Additionally, although the URS study had samples taken from counties within the Barnett Shale area, there is no indication that the samples themselves were actually from the Barnett Shale production zone. Also, many times these VOC emissions are controlled by the operator to recover valuable products or to meet TCEQ permitting guidelines. An even worse flaw in the EDF study was to assume that summertime VOC emissions from condensate storage tanks are 4.8 times higher than those during the rest of the year. This assumption is not even close to

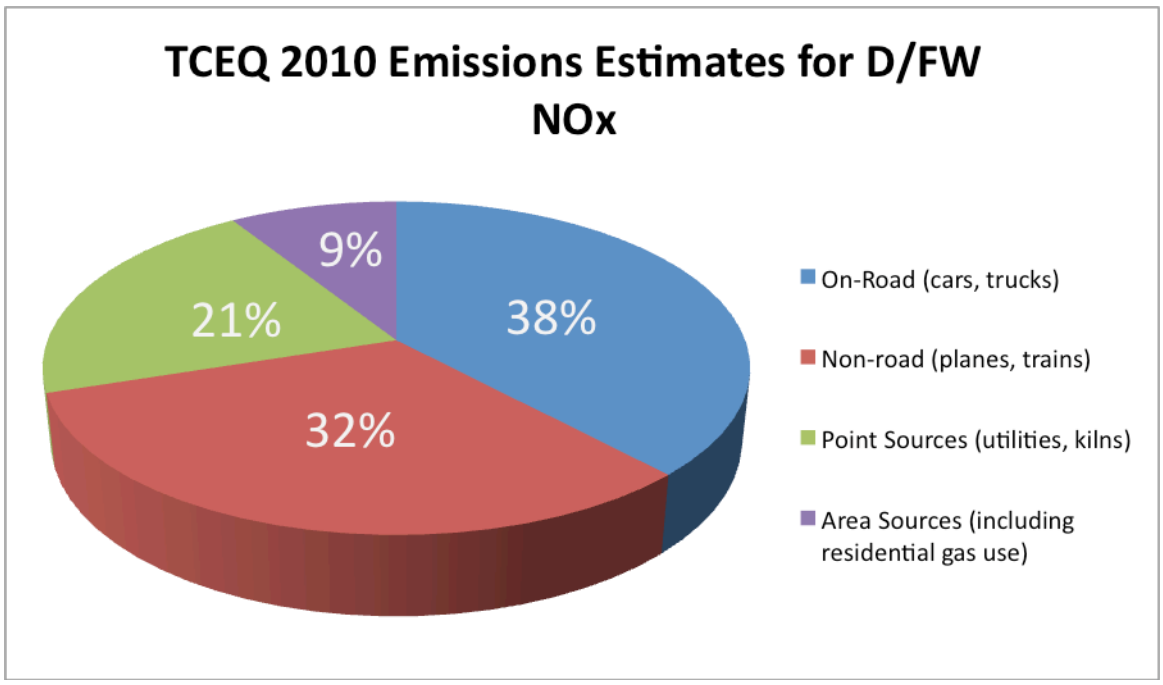
reality based on thermodynamic principals and results in a grossly overestimated number for VOC emissions during the summer.

Third, wind rose data from the DFW Airport (shown below for the month of July) demonstrates that during the summer months the wind blows from the west or northwest only about 4% of the time. Therefore, during the summer months, any VOC emissions actually emitted from condensate production tanks in counties west or northwest of the DFW NAA, and even in western Denton and Parker counties, is blown away from the DFW metroplex the vast majority of the time. The probability of any actual VOC emissions from these western areas significantly impacting high average 8-hour ozone values in the DFW NAA is likely near zero.



There are other significant flaws in the EDF study that are too technical to air within any public article or debate. The main point to keep in mind is that it is the TCEQ that is responsible for evaluating pollutant emissions in the DFW NAA and their impact on ozone formation. Based on guidance from the EPA, Texas developed a State Implementation Plan (SIP) in 2007 to address these emissions challenges. As part of this plan, the Texas Commission on Environmental Quality released estimated figures for 2010 NOx emissions by source. The TCEQ considers emissions of NOx as the most important precursor to the formation of ozone in the DFW NAA, rather than VOC, based on sensitivity air modeling studies. This is why most of the major emissions control efforts in the DFW NAA have been targeted for significant reduction of NOx emissions. The TCEQ data indicates that the majority (38%) of NOx emissions in the metroplex area are from

on-road vehicles, such as cars and trucks. Non-road mobile sources, such as planes, trains, and construction equipment (including some of the emissions from natural gas production activities) come in a close second at 32%. Emissions from area sources (including most of the oil and gas industry emissions) come in significantly lower at 9%.



As you can see, everyone across the board shares in the challenge to reduce emissions and improve air quality. The natural gas industry is no exception. For instance, as part of Texas' 2007 SIP, compressor engines over 50 HP are now required to meet NOx emissions standards that are three to four times more strict than current EPA standards. The natural gas industry will spend over a hundred million dollars to install emissions control equipment on compressor engines and monitoring to meet these federal and state standards and to demonstrate future compliance. Nonetheless, the citizens can be assured that the natural gas industry will continue to work with TCEQ in a cooperative manner to achieve an accurate assessment of emissions in the DFW NAA and do their part to achieve the new EPA ozone standard of 75 ppb.

In summary, it is clear that the data in the EDF study does not support it's implication that natural gas production activities in the Barnett Shale contribute to ozone levels in the D-FW metroplex to the same extent, or even close to the same extent, as on-road vehicles. To the contrary, natural gas, including that from the Barnett Shale, offers a way to help clean up the air. Natural gas is the cleanest burning hydrocarbon and is considered to be the bridge fuel to the future of more renewable and cleaner fuels. Natural gas will be the fuel of choice for decades to come for electric power generation and in natural gas powered vehicles. Production from the Barnett Shale has been and will continue to be an important part of the total supply of natural gas in the United States.