

# **The “Path Forward” for the Southeast Missouri Region with Regards to Ground-Level Ozone and Other Air Pollutants**

November 2018

Environmental Quality Committee

Southeast Missouri Regional Planning Commission



TITLE: The “Path Forward” for the Southeast Missouri Region With  
Regards to Ground-Level Ozone and Other Air Pollutants

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ABSTRACT:

With the release of recommendations for nonattainment areas under the ground-level ozone National Ambient Air Quality Standards (NAAQS) by the Missouri Department of Natural Resources (DNR) and the final monitor reading data for the 2018 ozone “season” in hand, the immediate pressure is off of the seven southeast Missouri Counties of Bollinger, Cape Girardeau, Iron, Madison, Perry, St. Francois and Ste. Genevieve. The area contains two monitors, one near the unincorporated community of Farrar in Perry County and one near Bonne Terre but located within Ste. Genevieve County. As of the 2015 season, on which DNR based their recommendations, both monitors were comfortably in compliance with the NAAQS of 70 parts per billion (ppb) with the Farrar monitor showing a design value of 66 ppb and the Bonne Terre monitor at 65 ppb. Moreover, final 2018 data remained in compliance with Farrar and Bonne Terre showing 66 and 65 ppb readings respectively although this data has not been through quality assurance protocols at this writing. This marked an improvement of 1 ppb for Farrar with Bonne Terre unchanged.

When the Ozone Advance program was established by the U.S. Environmental Protection Agency, the Commission applied to, and was accepted into the program. This document represents the fifth revision to the “Path Forward” that the Environmental Quality Committee has adopted. The Commission lacks the authority to impose any restrictions or controls. Instead, this “Path Forward” continues to propose a wide ranging citizen outreach and education program to address the myriad area sources of ozone precursors.

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Cover photo: Mississippi River workboat engines replaced under the Diesel Emissions Reduction Act program. The man in the picture for scale is 6’5” tall.

## Background:

Ozone, along with carbon monoxide (CO), particulate matter (pm), lead (Pb), sulfur oxides (SO<sub>x</sub> (primarily sulfur dioxide (SO<sub>2</sub>)) and nitrogen oxides (NO<sub>x</sub>) are the “Criteria Pollutants” identified under the Clean Air Act. These air pollutants are considered to be indicators of general air quality. In theory, if these pollutants can be controlled the overall quality of air in the nation will be improved and maintained.

For this document, ozone is the pollutant that matters. Ozone, along with particulate matter, is a primary component of smog. This highly reactive molecule is an irritant to the entire respiratory system. In higher concentrations noses run, eyes water, coughing and sneezing can get out of control. For those at risk, asthma attacks can be triggered. It is also associated with cardiac problems. Ozone is particularly harmful to the elderly and, paradoxically, the young since they spend so much time outdoors.

The Southeast Missouri Regional Planning Commission (RPC) serves seven counties in Missouri. Within these counties are two ozone air quality monitors, one in Ste. Genevieve County near the city of Bonne Terre, and one in Perry County near the unincorporated community of Farrar. These monitors brought a sense of urgency to the RPC in 2008 when the National Ambient Air Quality Standard (NAAQS) for ground-level ozone was reviewed. When the allowable standard was reduced from 84 parts per billion (ppb) for ground-level ozone to 75 ppb the region’s monitors were in danger of being noncompliant with the new standard.

The RPC worked closely with the Missouri Department of Natural Resources (DNR) from April, 2008 through the completion of the nonattainment area recommendation process in December of that year. This coordination involved:

1. hosting meetings in cooperation with DNR;
2. attending every meeting on the subject held by DNR;
3. undertaking independent research;
4. preparing a formal Position Paper;
5. contracting with a private engineering firm with a national reputation in environmental matters; and,
6. testifying before the Missouri Air Conservation Commission (MACC).

These efforts were successful. The final recommendations, prepared by DNR, approved by the MACC, and ultimately forwarded to the U.S. Environmental Protection Agency (EPA) by Governor Jay Nixon in December, 2008 included Ste. Genevieve and Perry Counties as separate, single-county nonattainment areas. This reflected the best outcome from the point of view of the RPC since earlier drafts of the recommendation had included these two counties into the St. Louis Missouri/Illinois nonattainment area. Ultimately, as the latest monitor readings were finalized, neither county was designated as a nonattainment area based on readings that had a design value in compliance with the 2008 NAAQS standard of 75 parts per billion.

There was a similar sense of urgency when discussions of revising the NAAQS down to the “range of 60-70 ppb” began as early as 2010. That effort was subsequently dropped and EPA did not release the new NAAQS until October 1, 2015. At that time the new standard was set at 70 ppb. At this level both of the monitors within the RPC service area are in compliance as of November 2018 which

includes monitoring data (unverified and still awaiting full quality control protocols) through the end of the 2016 ozone “season.” With the Bonne Terre monitor’s design value at 65 ppb and the Farrar monitor’s design value at 66 both monitors are in compliance. Indeed, the Farrar monitor’s design value was down 1 ppb from the previous year.

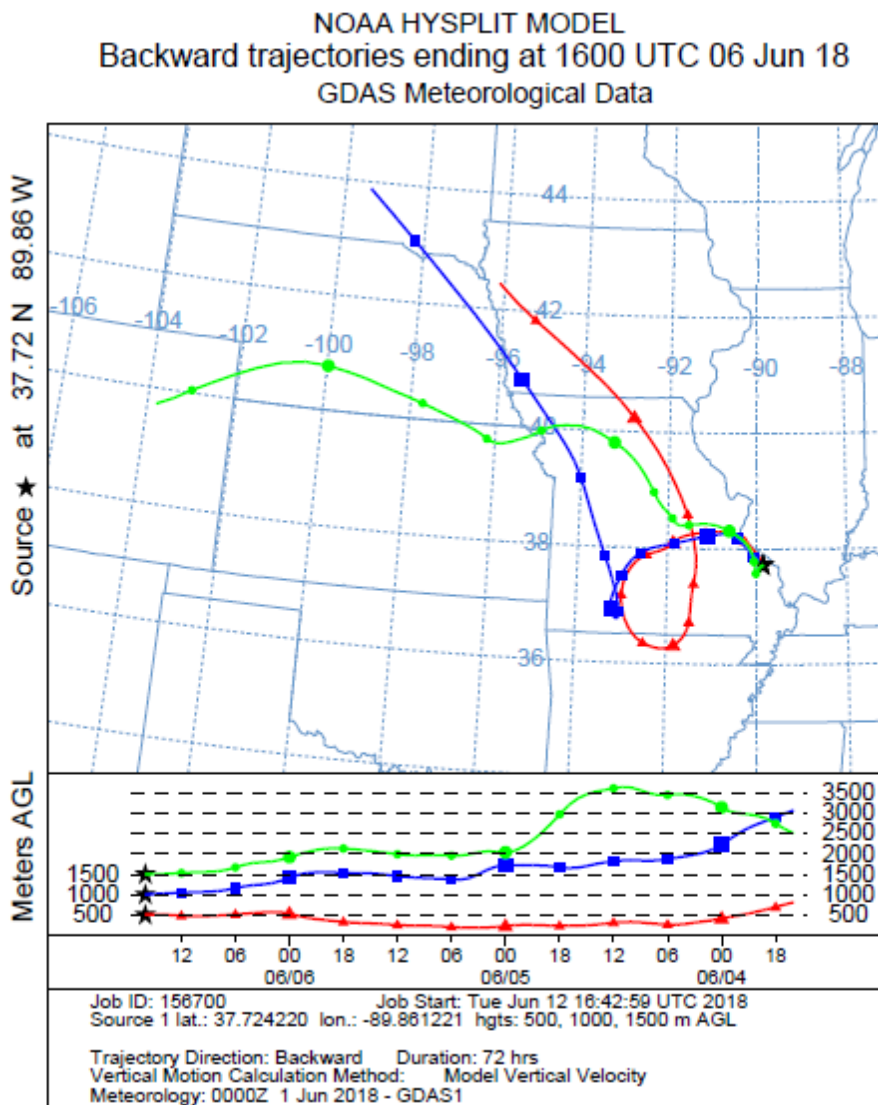
The RPC recognized that ozone in particular and air quality in general were issues of ongoing concern and as a result an Air Quality Committee, comprised of elected officials, industry representatives, concerned citizens, and representatives from local schools, was formally established. This committee provided guidance as the Southeast Missouri Clean Air Action Plan (CAAP) was developed and later publicized through local media outlets. This plan was ultimately adopted by Resolution by the RPC in October, 2009. The plan subsequently received formal Resolutions of Support from all seven member counties and most of the member communities. The CAAP received an Innovation Award from National Association of Development Organizations in 2010. The “path forward” presented in the following pages is based on the CAAP. In 2013, recognizing that the Regional Planning Commission should be addressing environmental issues beyond air quality the committee was renamed as the Environmental Quality Committee although its focus has remained largely on air quality since 2014-15 saw the NAAQS reviewed. The Environmental Quality Committee also serves as the Advisory Committee to the Southeast Missouri Solid Waste Management District.

During the exceptionally hot summer of 2012, both of the region’s ozone monitors had readings that were out of compliance with the NAAQS for ground level ozone. Fourth highest readings were up to 83 ppb. These readings drove the “design value” of the two monitors up from previous levels. The “design value,” the rolling average of the most recent three year’s fourth highest readings, is important because that is the number on which nonattainment area designations are based. When all was said and done, the design value of the Bonne Terre monitor remained in compliance with the then current standard of 75 ppb, although barely, at 75 ppb. The Farrar monitor was out of compliance with a design value of 77 ppb.

The Summer of 2013 was much cooler. Fourth highest readings for the Perry and Ste. Genevieve County monitors were 65 and 64 ppb respectively. This yielded a design value for the monitors for the 2011-13 period of 71 ppb for the Perry County monitor and 70 ppb for the Ste. Genevieve County monitor. The ozone season of 2014 repeated this pattern with a design value of 72 for the Bonne Terre monitor and 71 for the Farrar monitor. Another cool summer in 2015 brought those values to 65 for Bonne Terre and 66 for Farrar. With 2016 data in, the design values for both monitors crept up slightly to 66 for Bonne Terre and 67 for Farrar but both remain in compliance. The 2017 ozone season was more-or-less a repeat of this pattern. The fourth highest values for Bonne Terre and Farrar were 65 and 67 ppb respectively. The Bonne Terre monitor had only two exceedances all year, one early in the season on May 13, 2017 and one during a brief “heat wave” on July 24, 2017. As the 2018 ozone season is completed both monitors are again in compliance. These moderate readings are reflected in the DNR recommendation that only the existing St. Louis Missouri/Illinois nonattainment area be retained with the balance of the state designated as “unclassifiable/attainment” under the 2015 NAAQS.

The single exceedance reported for the Farrar monitor in 2018 provides a good example of how the transportability of ozone impacts rural areas. The back-azimuth plot from the National Oceanic and Atmospheric Administration’s HYSPLIT program shows that the air received at the Farrar monitor on June 6, 2018, the day of the reading, clearly came from the St. Louis metropolitan area. A copy of that plot is presented below. On that day St. Louis monitors showed 98 ppb at the Blair Street monitor,

73 ppb at the Maryland Heights monitor, 72 ppb at the Orchard Farms monitor and 84 ppb at the West Alton monitor.



## Ozone Advance Program:

To address the issue of ground-level ozone the Southeast Missouri Regional Planning Commission proposes the following program:

Saturation program to educate, inform, and persuade citizens of the southeast Missouri region to undertake the no-cost changes in behavior that can affect levels of ozone in the atmosphere.

This is unchanged since the previous update of the Path Forward.

### Rationale:

Ozone is not normally formed directly. Rather, a combination of Volatile Organic Compounds (VOCs) and Oxides of Nitrogen (NO<sub>x</sub>), called “precursors,” combine on warm days in the presence of sunlight to form ozone (O<sub>3</sub>). If any of these components are absent, ozone formation simply does not occur. 2012, with its well documented “heat wave,” low wind levels, drought conditions with very low humidity and clear skies provided the perfect recipe for ozone formation and this resulted in high monitor readings.

The problems facing the rural southeast Missouri region were further highlighted when the 2011 National Emissions Inventory (NEI) was released. This information, combined with a better understanding of whether or not an area is “NO<sub>x</sub> limited” or “VOC limited” points out very clearly just how limited the options available to the region are when it comes to dealing with the issue of ground-level ozone. The 2014 NEI identified “fires” as a significant source of precursors, primarily VOCs. This is a temporary and short-lived event, but given the proximity of the Flint Hills region where upwards of 3,000,000 acres are burned each spring to maintain the last unplowed high grass prairie in the United States, it can be significant if ozone spikes are noted when identifiable fires are burning. Far from being unique to the southeast Missouri region, the core problem of diverse sources and lack of authority to control are endemic to all rural areas.

Since ozone is not a “primary” pollutant a better understanding of how it is formed is needed. It is not formed directly except in rare and extreme cases (the vicinity of a lightning strike for example). Rather, ozone is a secondary pollutant formed from reactions with primary pollutants. These are the “precursors” discussed above and include oxides of nitrogen (NO<sub>x</sub>) and volatile organic compounds (VOCs).

There are two separate cycles that need to be understood. The NO<sub>x</sub> cycle is, in its simplest form:



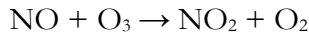
or



The free oxygen atom, then, combines as –



The cycle is completed when the sun goes down, removing the “sunlight” from the cycle and yielding –



And the Cycle is complete.

The NO<sub>x</sub> part of the cycle, then, is more or less a “zero sum game.” The problem is when VOCs get involved. They do not actually produce ozone but, rather, they disrupt the natural process that destroys ozone during the “after dark” part of the NO<sub>x</sub> cycle.

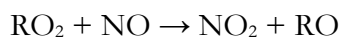
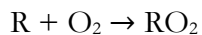
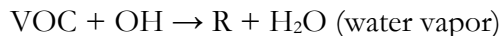
Volatile Organic Compounds are carbon based compounds, typically long chains of carbon and hydrogen atoms (hence the term hydrocarbons). The VOCs photochemical cycle results in more NO<sub>2</sub> available than would be normally, thereby increasing the ozone volume. To follow this cycle two more terms are necessary.

First is “Free Radical.” In chemical terms, this is a highly reactive group of atoms that combine with other atoms very easily

Second is the hydroxyl radical (OH), a single oxygen and single hydrogen atom. This is abundant in the atmosphere.

The OH radicals react with VOCs (long chain hydrocarbons) to produce a free radical RO<sub>2</sub> where R is one of the many possible VOC compounds.

The VOC part of the cycle is shown as, again vastly simplified:



This cycle leaves excess NO<sub>2</sub> available to go back to the first set of transformations and make more ozone leading to a buildup. The University of North Carolina at Chapel Hill has done a study on this and identified areas that are “NO<sub>x</sub> limited” and areas that are “VOC limited.” This has important implications for what can be accomplished.

“A NO<sub>x</sub> limited region is one where the concentration of ozone depends on the amount of NO<sub>x</sub> in the atmosphere. This occurs when there is a lack of Nitrogen Dioxides thus inhibiting ozone titration when oxygen mixes with VOCs. In these regions, controlling NO<sub>x</sub> would reduce ozone concentrations.” Further in that study they note that “Rural areas are usually NO<sub>x</sub> limited due to the large amount of trees that produce high levels of VOCs.”

This is clearly the case for the Southeast Missouri region as identified in the charts and graphs presented as Exhibits No. 1 and No. 2. For purposes of this analysis the top four sources of either

NOx or VOCs were selected from the 2011 and 2014 National Emissions Inventories. Only 6 major categories of sources were needed to cover the top four sources in all seven counties.

It appears clear that the region meets the conditions to be described as NOx limited. Reviewing the “VOC Top Four Sources” section of the chart in Exhibit No. 1 shows that VOCs dramatically outweigh NOx in every county. Moreover, the total volume of VOCs outstrips all other factors, again, dramatically. Since the majority of these VOCs are identified as coming from “Biogenics – Vegetation and Soil” they are of a completely natural origin and not subject to controls or limits in any meaningful way.

And that leaves control of NOx as the potential method for local impact on our ozone levels. The only significant sources for NOx as identified in the area are “Biogenics – Vegetation and Soil,” “Mobile,” “Fuel Combustion” and “Industrial processes.” Biogenics are, again, primarily trees and plants in the forests as they fall and decompose. Mobile sources include on- and off-road vehicles, airplanes, rail and river transportation. Fuel combustion includes primarily process and space heat for manufacturing and other industrial operations. Industrial processes include, most relevant for purposes of this analysis, Cement Manufacturing and Mining.

In order then, let us review the potential mitigating actions that could be taken:

Biogenics – are essentially uncontrollable. In theory massive efforts to clean out decomposing plant matter from the forest floor would be possible, but it is not economically feasible nor does any entity have the authority to undertake such a project. Given the significance of biogenics as the primary source of VOCs, this simple fact demonstrates just how limited the possibilities for addressing the problem is in this rural area. The 2011 and 2014 NEI data shows biogenic sources of VOCs at 86.6% and 87.0% respectively. The next highest source, fires, is ephemeral and completely out of the control of local entities. No other source reaches 5% in terms of significance.

Mobile – mobile sources are far and away the most significant sources of NOx and have been the primary targets of the region’s efforts. These include the “stop at the click,” “plan your trips,” “watch your idling,” and other efforts to mobilize citizen involvement that have been centerpieces of the region’s efforts. In addition we have worked with Mississippi River barge operators and repowered seven workboats making significant improvements to the emissions characteristics of the inland waterway fleet.

Fuel Combustion – industrial space and process heat that involves air emissions above a *de minimis* level are already permitted and held to Best Available Control Technology (BACT) standards. Beyond that local government lacks any authority.

Industrial Processes – the same comments apply. Industry is already permitted and held to BACT standards. Local government lacks authority to impose more restrictions.

Fires – Fires are the second highest source of VOCs in all but two counties and in the regional aggregate. Lacking a chronology of when data is collected it is impossible to identify sources although it is reasonable to assume that the large controlled burns associated with the Flint Hills area and with rural agricultural practices in general are the primary sources. While it is possible that large forest fires could affect local air, this is assumed to be negligible for any planning purposes. This is another arena that is completely beyond any local control.

A very high percentage of ozone precursors are the result of citizen's actions. About half, for example, are from highway and off-highway vehicles. Each trip to the store, in other words, adds some VOCs and NO<sub>x</sub> to the atmosphere. For VOCs, the great majority (in excess of 90%) are produced by "biogenics." For NO<sub>x</sub>, the more important consideration in this "NO<sub>x</sub> limited" area, "mobile" sources account for almost half (47%) of emissions, with "industrial processes" the single largest other source at 34%.

In rural areas such as the southeast Missouri region, there is essentially no "low hanging fruit." In urban areas, for example, "Other Industrial Processes" might be addressed through controls on large manufacturing operations. Few such opportunities are available in rural areas. Similarly, controls on dry cleaners alone were considered important enough to be specifically included in the St. Louis nonattainment area programs. In rural areas, there are simply not enough dry cleaners to make this significant.

More to the point, even when such specific sources can be identified the Regional Planning Commission lacks authority to mandate controls. Such measures are solely within the authority of the Missouri Department of Natural Resources and the U.S. Environmental Protection Agency. The Environmental Quality Committee assumes that, should one or both monitors be out of compliance and, as a result, one or more counties designated as a nonattainment area(s), the State Implementation Plan would include any applicable measures.

With no large "point sources" to control, the much more dispersed "area sources" must, of necessity, become the target for reduction of ozone precursors. This, in rural areas, means basically all citizens.

### **Approach:**

In order to reach such a broad group the Commission has been engaged in a "Saturation Campaign of Awareness." Beginning in February, 2013, all media outlets were asked to help in reaching as many citizens as possible with a program to reduce ozone precursors being emitted. Staff provided information at the beginning of the ozone season, putting out the first information in March in anticipating of the April 1 start of the season. Since, under the new standards the ozone "season" is now considered to be March 1 through October 31 this schedule has been moved ahead and initial press releases will be made in February from now on. This has been followed up by weekly reports distributed to a broad mailing list including all local media.

Interest among media has fallen off since regular weekly reports have been consistently "no exceedances." As the old saying goes, "you never see a headline that reads '10,000 Airplanes Landed Safely Today.'" Consistently good news does not draw much attention. Nevertheless the activities of the Environmental Quality Committee have received reasonable coverage from the local media, especially when specific events such as the release of the new NAAQS drive interest.

The staff of the Regional Planning Commission will continue these outreach efforts. Regular press releases, email notifications, and reports on monitor readings will continue. This information campaign will focus on the specifics identified below.

## Specifics:

1. “Stop At the Click for Clean Air.” Modern vehicles are so well sealed that refueling is essentially pollution free, unless the systems are overridden. The most common way that this occurs is with “topping off” the tank. A simple “stop at the click” program can avoid this. Since every vehicle is fueled regularly, this is also the most direct way of reaching the widest audience.
2. “Fuel in the Evening for Clean Air.” Although fueling a modern vehicle is “almost” pollution free, it is not “completely” pollution free. By simply waiting until the evening, or changing your habit to fueling on the way home from work rather than on the way to work, the pollutants that do escape into the atmosphere have time to disperse before the heat of the following day starts cooking ozone.
3. “Mow in the Evening for Clean Air.” Oddly, the small engines that power Outdoor Power Equipment are much more polluting than the much larger modern vehicle engines. Small engines lack the sophisticated fuel management systems of vehicles, virtually all of which use electronic fuel injection. Also, the two-stroke cycle engines require oil mixed with fuel for lubrication, leading to air pollution issues.
4. “Plan Your Trips for Clean Air.” This specific component focuses on habits. It is common to “hop into the car” and run to the store for a small purchase. Later, a second trip might be made to the video rental store and a third to the library and a fourth to visit a friend and so on. The simple combination of trips to eliminate some takes vehicles off of the road and pollutants out of the air.
5. “Tune Your Car for Clean Air.” Cars that are tuned up pollute less. It is that simple. As part of this, other maintenance such as checking tire air pressures is important to keeping your vehicle as efficient as possible.
6. “Conserve Energy for Clean Air.” This component of the project focuses on the biggest producer of precursors, electric generation utilities (EGUs). Lowering demand has two impacts. First, the utilities can run at something under 100% and therefore emit less into the air. Second, enough reduction in demand means that new plants will not have to be built. This is important since even modern, well controlled EGUs are still large emitters of NO<sub>x</sub> with upwards of 20 percent of NO<sub>x</sub> coming from EGUs. Also, reduction in energy use equates to a reduction in energy bills.
7. “Ozone Alert System.” This component of the project focuses on tracking weather and temperature conditions and instituting an “ozone alert” or “ozone warning” system. The existing systems available through the National Oceanic and Atmospheric Administration will be a central component of this effort and the RPC will serve as the dissemination point. A simple email alert system will get the information to the media.

The Regional Planning Commission has been closely involved in the formation of a new Metropolitan Planning Organization (MPO) for transportation planning in the Cape Girardeau/Jackson Micropolitan Area. Specifically for the City of Cape Girardeau, the largest city in the region, a recommendation will be made to the MPO encouraging the city to investigate the possibility of timing traffic signals for improved traffic flow. Anecdotally, the existing system lends itself to forced idling at virtually every stop light. This improvement would cut down on idling time, reduce trip time and reduce fuel use through improved efficiencies.

### ***Initial Organization***

The key to this project is participation across the media spectrum. Print, radio and television must all be involved or there is no chance whatsoever that this project will accomplish anything. Therefore, the initial organizational outreach was directed at key personnel from this group.

Besides these traditional outreach vehicles, social media has been part of the effort. Facebook and LinkedIn pages were established and a Twitter feed was started by the RPC. Where online local information outlets can be identified (the Viburnum News for example), they were invited into the effort as well.

### ***Diesel Emissions Reduction Act Program***

Although there is no “low hanging fruit,” a point made throughout this Path Forward, there is one program with potential to directly impact not only the Southeast Missouri Regional Planning Commission’s service area, but the entire Mississippi, Ohio, Illinois, and Tennessee river valleys. The Regional Planning Commission has been very active and successful in participating in the Environmental Protection Agency’s Diesel Emissions Reduction Act (DERA) program. DERA funds have shown a leverage ratio of roughly 4:1, private:public money and have been used to repower seven Mississippi River workboats. The large diesel propulsion engines on these boats run 24/7/365 and, since the boats can be refitted and refurbished to a virtually indefinite useful life, old engines stay in service. Through the DERA program funding 14 unrated Tier 0 engines have been, or soon will be, replaced with new Tier 3 rated engines.

The Commission has not charged administrative costs to these grants. Rather, we have considered this as part of our participation in the Ozone Advance program. This policy will be carried forward in any future grants through the DERA program.

### ***Tracking Electric Vehicle Charging Stations***

There are few public electric vehicle charging stations in the region. Indeed, of six identified on [plugshare.com](http://plugshare.com), four are public and two are privately owned although available to plugshare users. The U.S. Department of Energy Alternative Fuels Data Center has no listing for charging stations in the region. To promote an increase in electric vehicle use the availability of charging stations, either publicly or privately owned, will be publicized. Press releases and follow-up stories regarding this will be made to all local media.

### ***Promotion of Carpooling/Ride Sharing***

Transit operators have been pro-active in the area of ride sharing. The Cape Girardeau County Transit Authority, for example, operates a van from a pickup point in the city of Cape Girardeau to transport employees to the large employer Gilster-Mary Lee in Perryville. Outreach efforts will be made to promote this arrangement, or simply present possible carpooling benefits to other large employers in the region.

### ***Promotion Smartway Program***

Several local owner-operators have taken advantage of Diesel Emission Reduction Act funding to install Auxiliary Power Units on over-the-road trucks. With significant funding potentially available through the Volkswagen settlement, RPC staff hope to be able to extend this project using these funds.

### ***Timing and Milestones***

The program will be initiated and operated to correspond with the ozone season. Specifically:

February/March, 2018 – reminder contacts. This has been accomplished with every identifiable radio station and newspaper of record in the region contacted and alerted to the upcoming program.

March/April, 2018 – seek support for public service announcements. This was initiated but results so far have been disappointing.

March 1 through October 31, 2018 – regular updates, twitter and facebook announcements, ozone alert system, monitoring, press releases. This has been initiated. The Missouri Department of Natural Resources provides a weekly summary of all ozone monitor readings in the state and this is forwarded to a wide mailing list of interested parties. A twitter account has been established as SEMO Air and regular “tweets” are posted regarding ozone and related issues.

February, 2019 – program review and analysis. A program report will be prepared by the end of February, 2019 summarizing the activities undertaken, and the results achieved.

### ***Summary of Results So Far***

The first year of the program, essentially the ozone season of 2013, was generally successful. The initial contacts were made regarding air quality issues, and specifically ozone issues received reasonably good coverage in the media. Weekly monitoring reports provided by DNR were forwarded to the Environmental Quality Committee and a mailing list of “interested parties” including all media outlets.

Since, however, 2014 – 2018 have proven to be seasons marked by extremely mild weather there was no particular sense of urgency. The old joke is that “you will never see a headline reading 10,000 planes landed safely today.” In that vein, media coverage was spotty. The reports were picked up and staff gave a few interviews on the subject. The full participation never materialized though, as had been anticipated. Similarly, inquiries were made to prepare Public Service Announcements but no response was forthcoming.

For 2019 RPC staff will continue the program of forwarding weekly monitoring reports. This program has received regular feedback. The release of the new NAAQS by EPA has stimulated interest in air quality as well. Staff has already been interviewed a few times on that subject.

**Exhibit 1**

**Top Four Sources of VOC and NO<sub>x</sub>**

**Table Form**

## Southeast Missouri Region

### Sources of VOCs and NOx

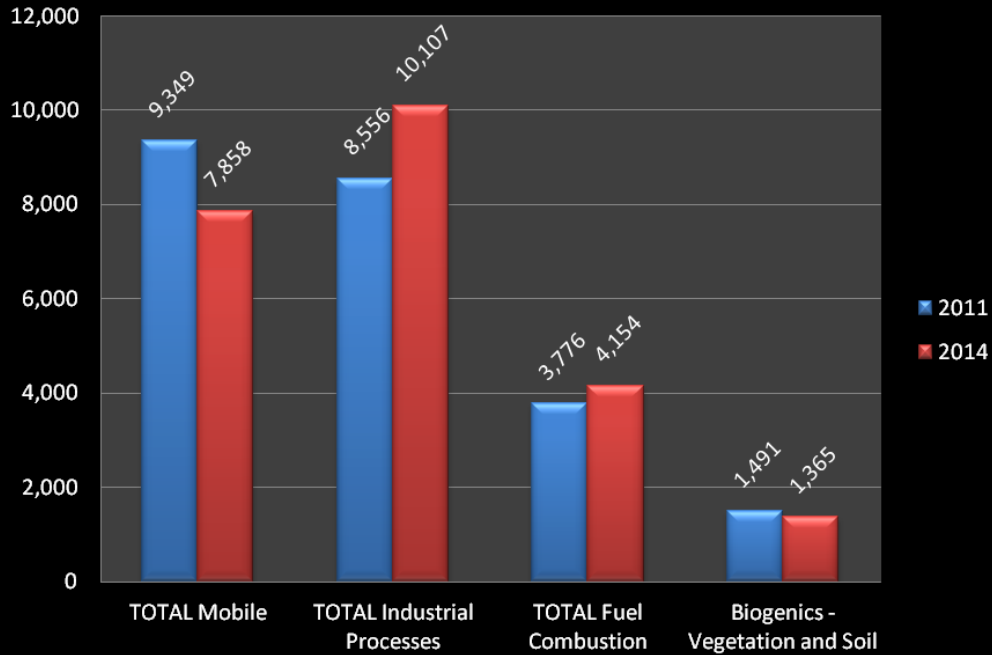
	Biogenics - Vegetation and Soil		Mobile		Fuel Combustion		Industrial Processes		Fires		Solvents	
	2011	2014	2011	2014	2011	2014	2011	2014	2011	2014	2011	2014
<b>NOx Top Four Source County</b>												
Bollinger	275	245	474	405	2,942	3,213			67	57		
Cape Girardeau	357	308	3,217	2,682	245	200	1,213	1,079				
Iron	110	105	401	355			53	104	160	50		
Madison	126	126	494	436	269	350			33	13		
Perry	269	239	1,577	1,177	68	80			16	42		
St. Francois	158	155	1,781	1,578	118	101	417	412				
Ste. Genevieve	196	187	1,406	1,226	90	169	6,869	8,513				
REGION TOTAL	1,491	1,365	9,349	7,858	3,731	4,114	8,553	10,107	278	162	-	-
<b>VOCs Top Four Sources</b>												
Bollinger	13,419	12,641	254	228	119	168			1,380	877		
Cape Girardeau	7,316	6,516	1,141	1,011			482	387			758	857
Iron	19,217	17,339	242	216					2,794	1,183	73	81
Madison	15,405	13,383	424	378			98	91	641	260		
Perry	8,118	7,916	508	428					215	493	425	586
St. Francois	10,973	9,666	815	770					1,104	1,817	486	514
Ste. Genevieve	10,935	10,255	444	383			329	357			486	514
REGION TOTAL	85,383	77,714	3,828	3,415	119	168	909	835	6,133	4,630	2,227	2,551

## **Exhibit 2**

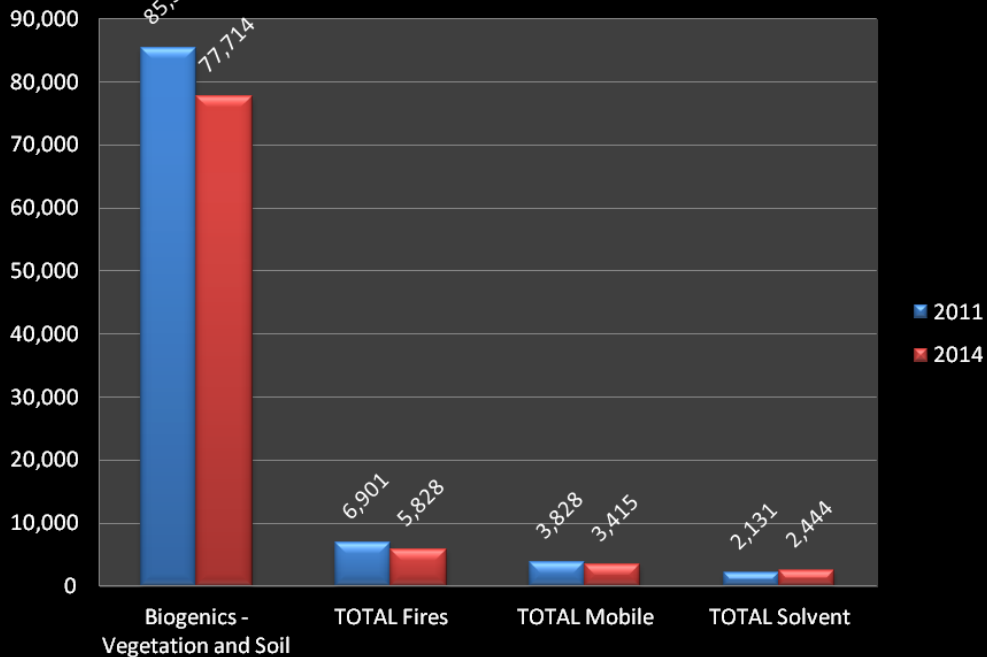
**Top Four Sources of VOC and NO<sub>x</sub>**

**Graphic Form**

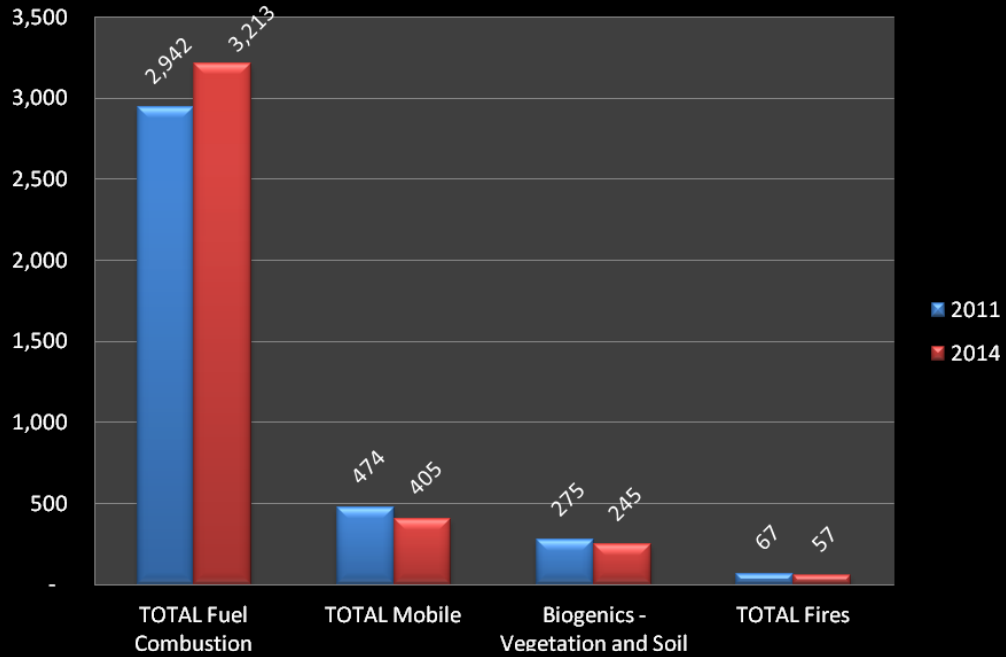
### SEMO REGION Top Four NO<sub>x</sub> Sources (tons) 2011 & 2014



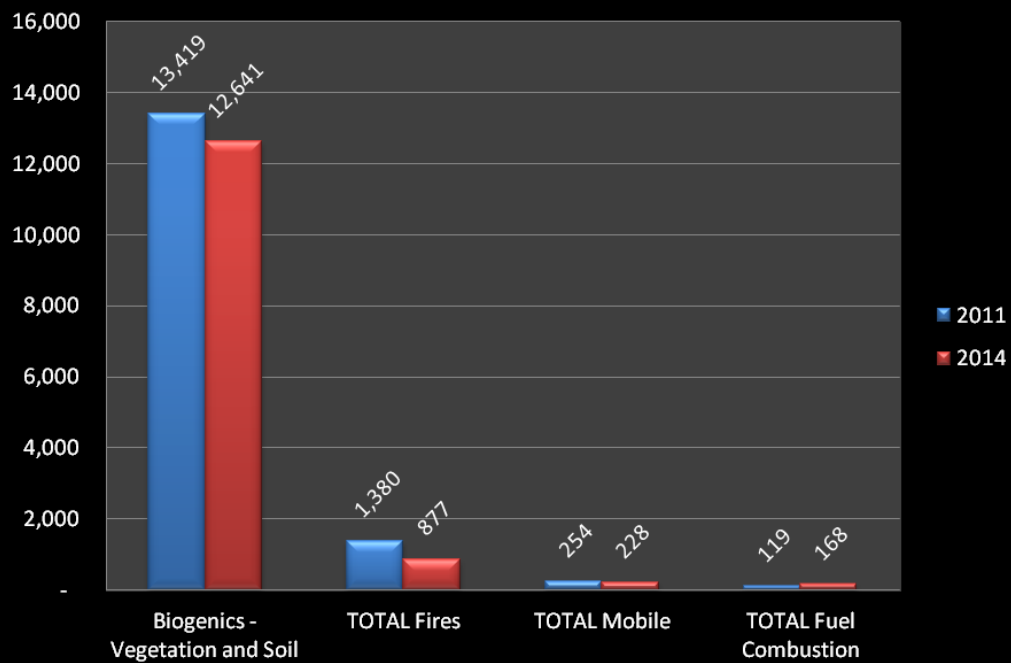
### SEMO REGION Top Four VOC Sources (tons) 2011 & 2014



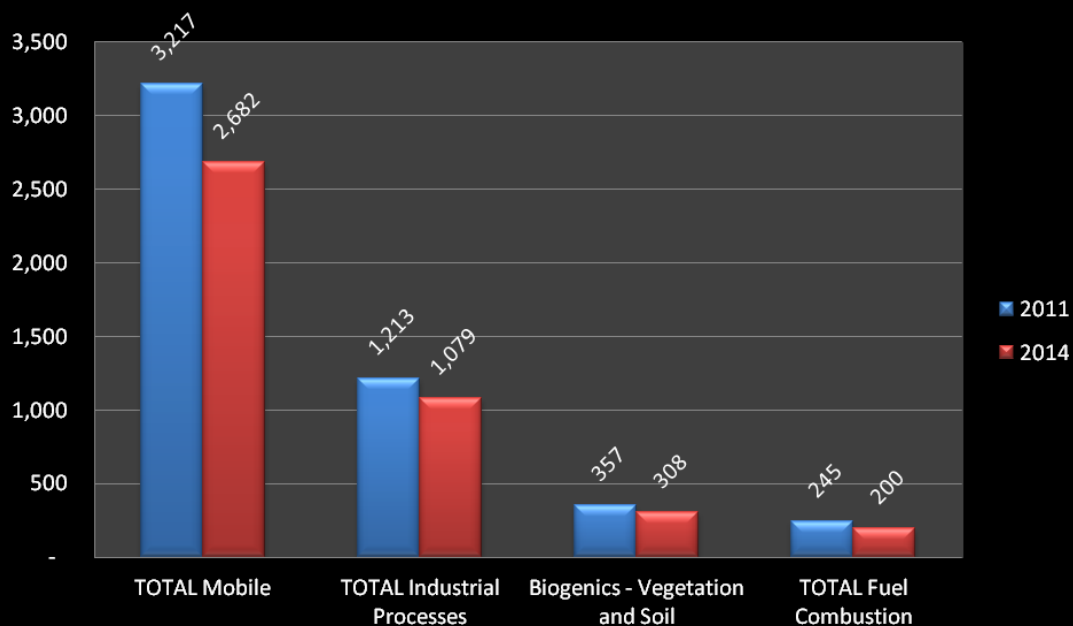
### Bollinger County Top Four NOx Sources (tons) 2011 & 2014



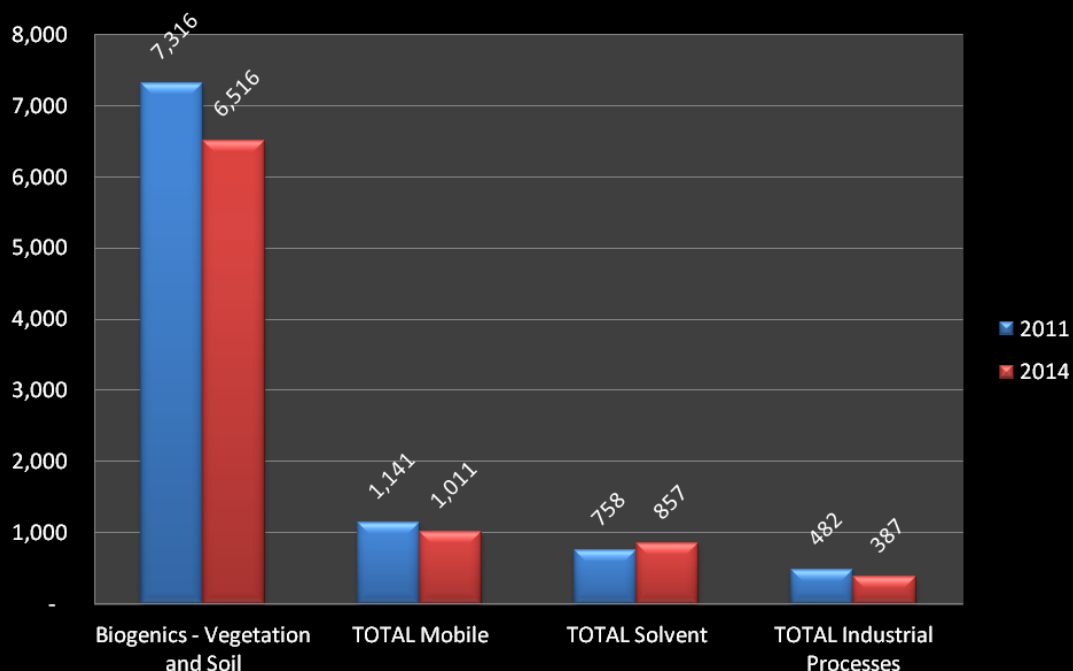
### Bollinger County Top Four VOC Sources (tons) 2011 & 2014



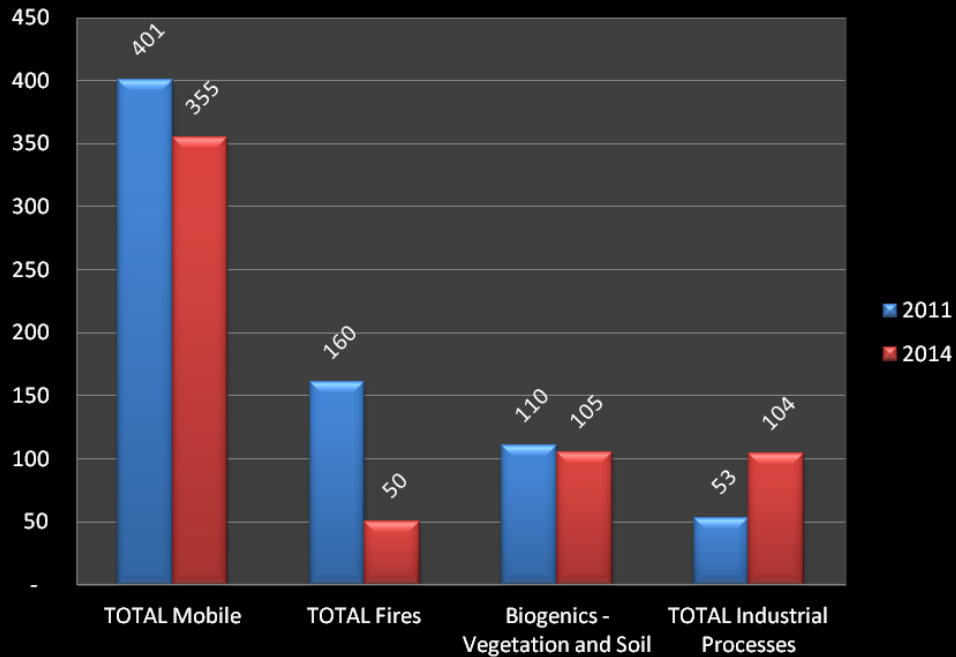
### Cape Girardeau County Top Four NOx Sources (tons) 2011 & 2014



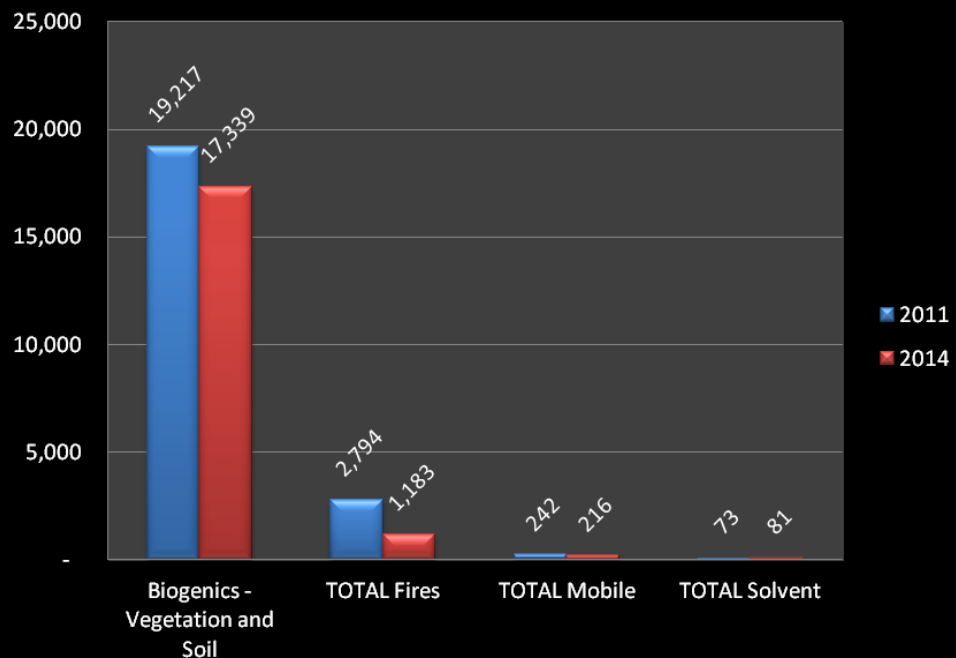
### Cape Girardeau County Top Four VOC Sources (tons) 2011 & 2014



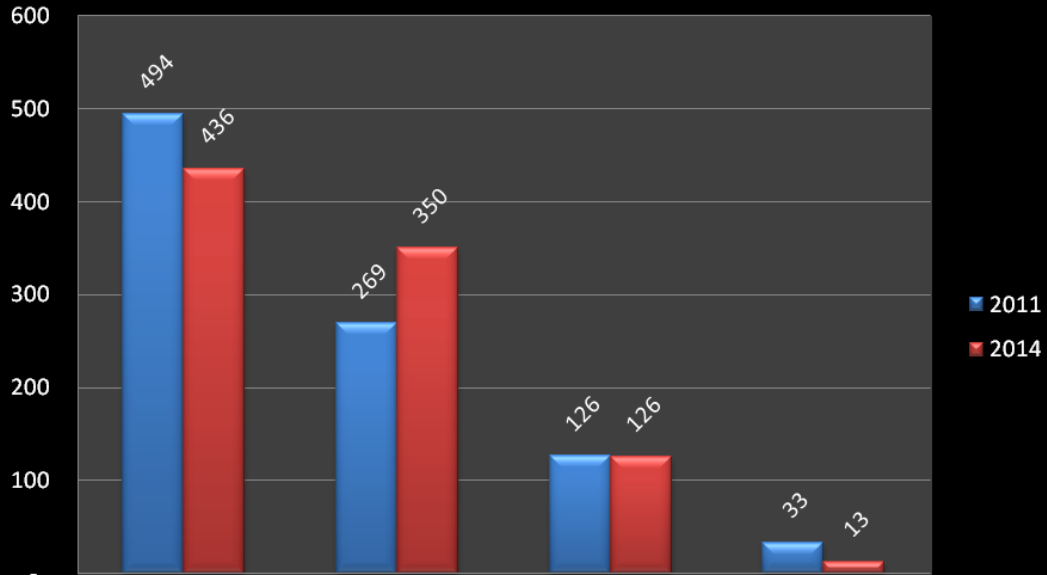
### Iron County Top Four NO<sub>x</sub> Sources (tons) 2011 & 2014



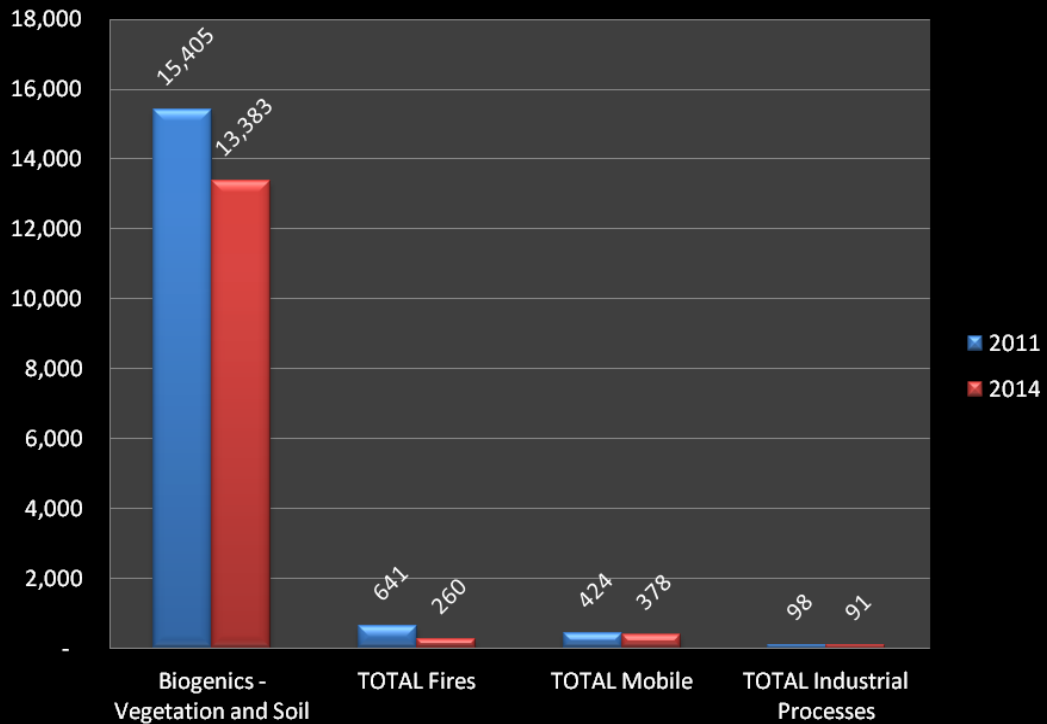
### Iron County Top Four VOC Sources (tons) 2011 & 2014



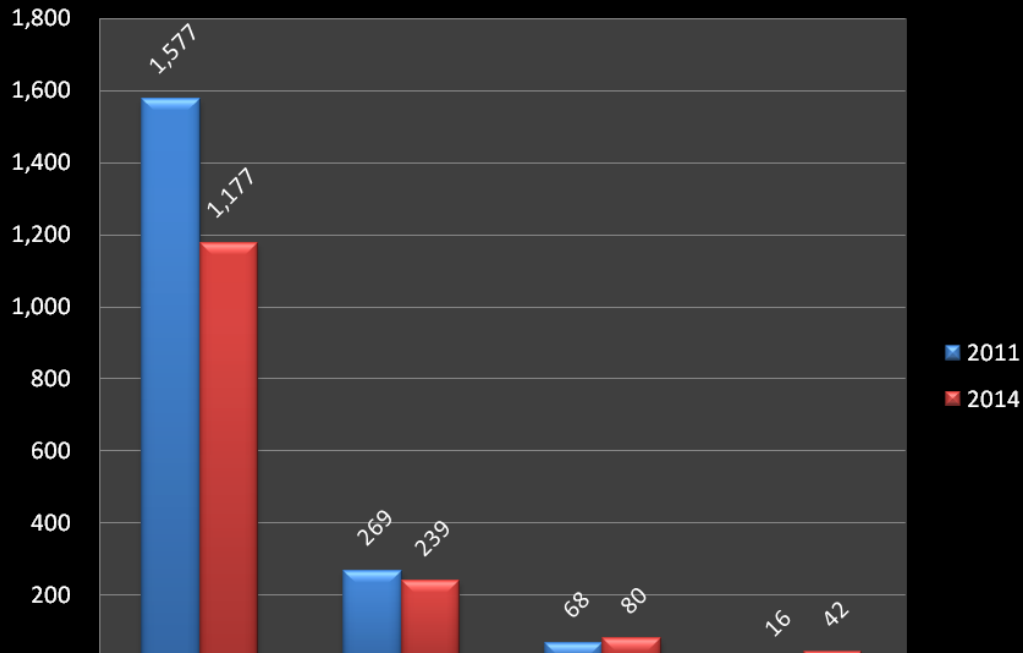
### Madison County Top Four NOx Sources (tons) 2011 & 2014



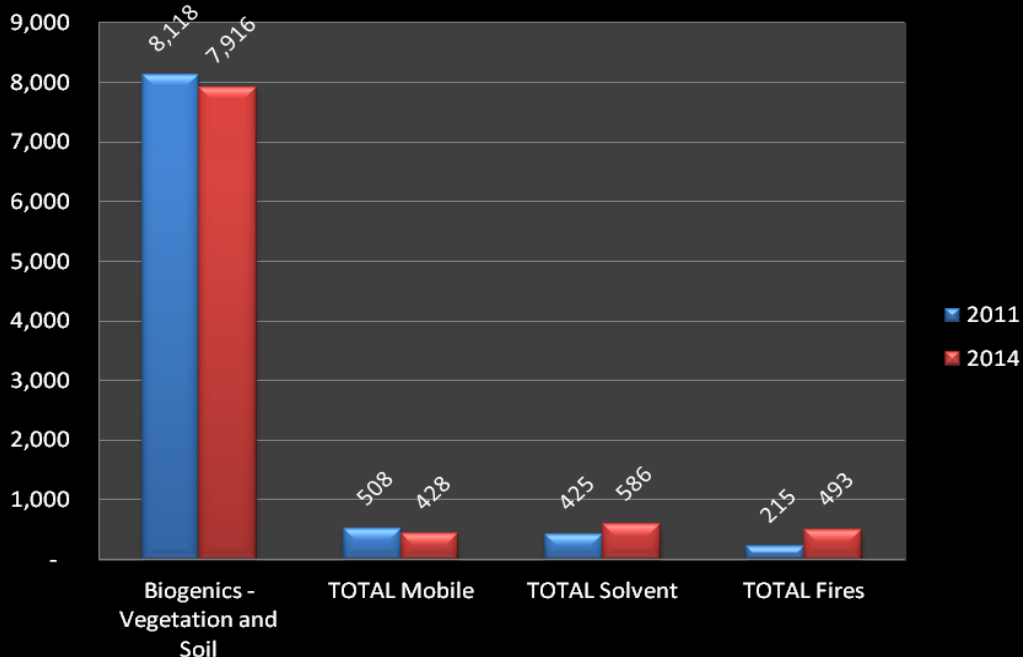
### Madison County Top Four VOC Sources (tons) 2011 & 2014



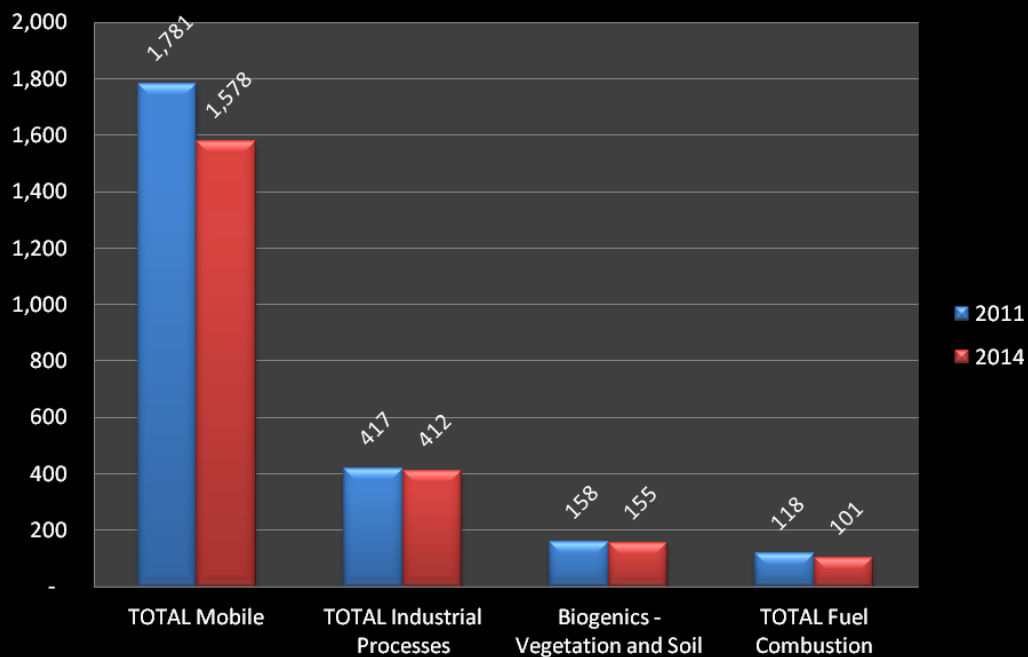
### Perry County Top Four NOx Sources (tons) 2011 & 2014



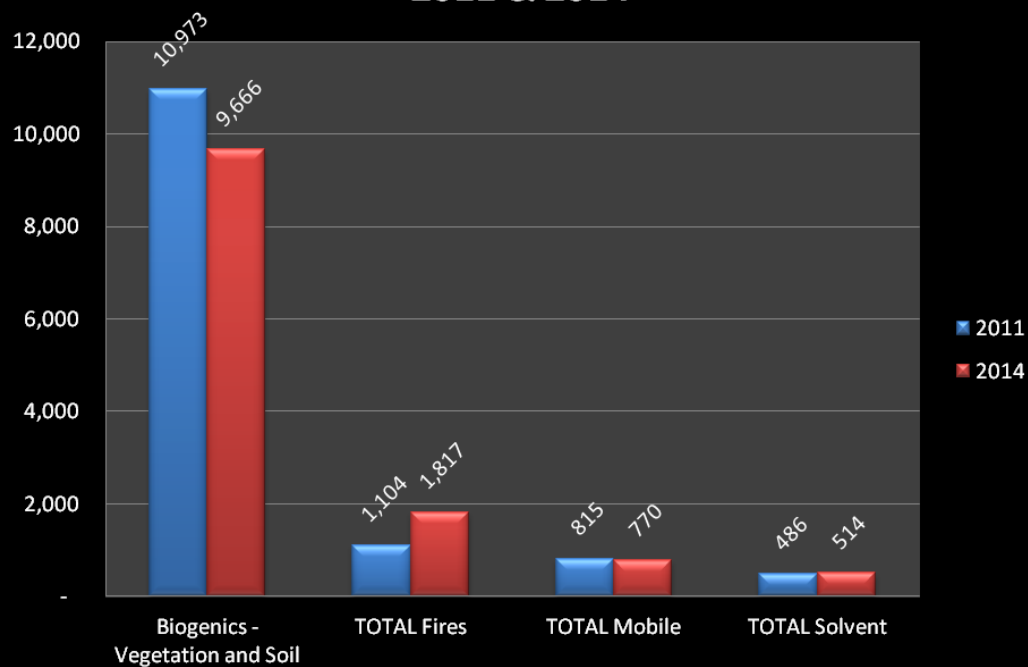
### Perry County Top Four VOC Sources (tons) 2011 & 2014



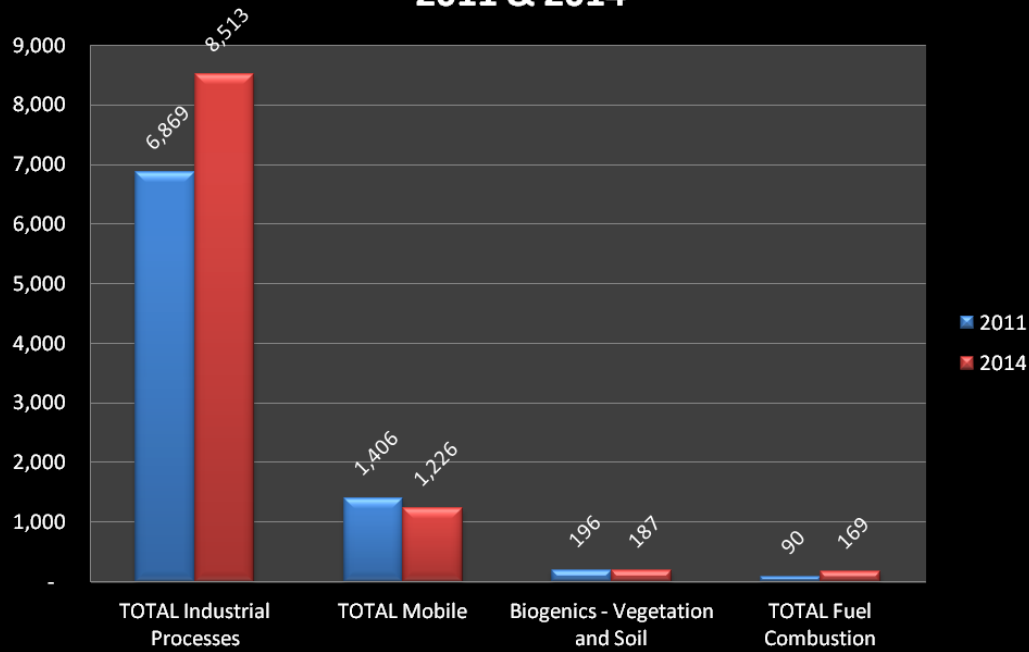
### St. Francois County Top Four Sources of NO<sub>x</sub> (tons) 2011 & 2014



### St. Francois County Top Four Sources of VOC (tons) 2011 & 2014



### Ste. Genevieve County Top Four NO<sub>x</sub> Sources (tons) 2011 & 2014



### Ste. Genevieve County Top Four VOC Sources (tons) 2011 & 2014

