APPENDIX A

Air Quality System (AQS) Monitor Data Values for the Entire Cincinnati-Hamilton, OH-KY-IN Nonattainment Area

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AQS Monitoring Data for Kentucky's Portion of the Cincinnati-Hamilton OH-KY-IN 2008 8-Hour Ozone Nonattainment Area

KENTUCKY																
8-HOUR Ozone (44201)																
(PARTS PER MILLION)																
SITE ID	POC	PQAO	CITY	COUNTY	ADDRESS	YEAR	METH	%OBS	VALID DAYS MEAS	NUM DAYS REQ	1ST MAX 8-HR	2ND MAX 8-HR	3RD MAX 8-HR	4TH MAX 8-HR	DAY MAX > 0.075	CERT
21-015-0003	1	584	Not in a city	Boone	KY 338 & LOWER RIVER ROAD	2009	87	98	241	245	0.069	0.067	0.065	0.064	0	
21-015-0003	1	584	Not in a city	Boone	KY 338 & LOWER RIVER ROAD	2010	87	100	245	245	0.081	0.072	0.067	0.067	1	
21-015-0003	1	584	Not in a city	Boone	KY 338 & LOWER RIVER ROAD	2011	87	98	239	245	0.075	0.072	0.071	0.070	0	
21-015-0003	1	584	Not in a city	Boone	KY 338 & LOWER RIVER ROAD	2012	87	100	245	245	0.085	0.083	0.078	0.074	3	Y
21-015-0003	1	584	Not in a city	Boone	KY 338 & LOWER RIVER ROAD	2013	87	100	244	245	0.071	0.062	0.060	0.059	0	Y
21-015-0003	1	584	Not in a city	Boone	KY 338 & LOWER RIVER ROAD	2014	87	100	245	245	0.064	0.064	0.062	0.062	0	Y
21-037-3002	1	584	Highland Heights	Campbell	524A John Hill Road	2009	87	100	245	245	0.075	0.072	0.070	0.068	0	
21-037-3002	1	584	Highland Heights	Campbell	524A John Hill Road	2010	87	97	238	245	0.080	0.075	0.075	0.073	1	
21-037-3002	1	584	Highland Heights	Campbell	524A John Hill Road	2011	87	99	243	245	0.084	0.084	0.080	0.080	12	
21-037-3002	1	584	Highland Heights	Campbell	524A John Hill Road	2012	87	99	242	245	0.106	0.089	0.084	0.084	12	Y
21-037-3002	1	584	Highland Heights	Campbell	524A John Hill Road	2013	87	100	245	245	0.079	0.076	0.072	0.072	2	Y
21-037-3002	1	584	Highland Heights	Campbell	524A John Hill Road	2014	87	99	242	245	0.074	0.074	0.072	0.071	0	Y
21-117-0007	1	584	Covington	Kenton	1401 DIXIE HWY, UNIVERSITY COLLEGE	2009	87	99	242	245	0.076	0.075	0.075	0.074	1	
21-[illegible]007	1	584	Covington	Kenton	1401 DIXIE HWY, UNIVERSITY COLLEGE	2010	87	37	90	245	0.075	0.068	0.066	0.064*	0	

* Monitor discontinued May 2010.

AQS Monitoring Data for Ohio's Portion of the Cincinnati-Hamilton, OH-KY-IN 2008 8-Hour Ozone Nonattainment Area

OHIO	8-HOUR Ozone (44201)		(PARTS PER MILLION)						VALID	NUM	1ST	2ND	3RD	4TH	DAY	
									DAYS	DAYS	MAX	MAX	MAX	MAX	MAX >	
SITE ID	POC	PQAO	CITY	COUNTY	ADDRESS	YEAR	METH	%OBS	MEAS	REQ	8-HR	8-HR	8-HR	8-HR	0.075	CERT
39-017-0004	1	1259	Hamilton	Butler	SCHULER AND BENDER	2009	87	98	201	214	0.079	0.078	0.074	0.073	2	
39-017-0004	1	1259	Hamilton	Butler	SCHULER AND BENDER	2010	87	99	212	214	0.083	0.083	0.081	0.077	7	
39-017-0004	1	1259	Hamilton	Butler	SCHULER AND BENDER	2011	87	100	214	214	0.085	0.081	0.079	0.078	8	
39-017-0004	1	1259	Hamilton	Butler	SCHULER AND BENDER	2012	87	100	213	214	0.095	0.090	0.089	0.083	15	Y
39-017-0004	1	1259	Hamilton	Butler	SCHULER AND BENDER	2013	87	98	209	214	0.070	0.070	0.069	0.068		
39-017-0004	1	1259	Hamilton	Butler	SCHULER AND BENDER	2014	87	99	212	214	0.080	0.072	0.071	0.070	1	Y
39-017-1004	3	1259	Middletown	Butler	HOOK FIELD AIRPORT	2009	87	100	214	214	0.078	0.076	0.076	0.076	4	
39-017-0018	1	1259	Middletown	Butler	1701 RUNWAY DR.	2010	87	99	212	214	0.086	0.081	0.081	0.080	13	
39-017-0018	1	1259	Middletown	Butler	1701 RUNWAY DR.	2011	87	100	214	214	0.094	0.084	0.083	0.082	11	
39-017-0018	1	1259	Middletown	Butler	1701 RUNWAY DR.	2012	87	95	203	214	0.088	0.087	0.085	0.084	12	Y
39-017-0018	1	1259	Middletown	Butler	1701 RUNWAY DR.	2013	87	100	214	214	0.076	0.070	0.068	0.068	1	
39-017-0018	1	1259	Middletown	Butler	1701 RUNWAY DR.	2014	87	99	212	214	0.075	0.073	0.071	0.069	0	Y
39-017-9991	1	1344	Oxford	Butler	ECOLOGY RESEARCH CENTER, MIAMI UNIVERSITY	2011	47	77	164	214	0.087	0.079	0.079	0.079	6	Y
39-017-9991	1	1344	Oxford	Butler	ECOLOGY RESEARCH CENTER, MIAMI UNIVERSITY	2012	47	93	198	214	0.097	0.088	0.087	0.085	11	Y
39-017-9991	1	1344	Oxford	Butler	ECOLOGY RESEARCH CENTER, MIAMI UNIVERSITY	2013	47	94	201	214	0.075	0.073	0.069	0.069	0	Y
39-017-9991	1	1344	Oxford	Butler	ECOLOGY RESEARCH CENTER, MIAMI UNIVERSITY	2014	47	94	201	214	0.074	0.072	0.071	0.069	0	
39-025-0022	1	1259	Batavia	Clermont	2400 CLERMONT CNTR.	2009	87	99	212	214	0.071	0.071	0.069	0.069	0	
39-025-0022	1	1259	Batavia	Clermont	2400 CLERMONT CNTR	2010	87	99	211	214	0.087	0.078	0.078	0.075	3	
39-025-0022	1	1259	Batavia	Clermont	2400 CLERMONT CNTR.	2011	87	99	212	214	0.097	0.093	0.085	0.082	9	
39-025-0022	1	1259	Batavia	Clermont	2400 CLERMONT CNTR	2012	87	100	214	214	0.107	0.097	0.094	0.091	13	Y
39-025-0022	1	1259	Batavia	Clermont	2400 CLERMONT CNTR.	2013	87	100	213	214	0.078	0.069	0.066	0.066	1	
39-025-0022	1	1259	Batavia	Clermont	2400 CLERMONT CNTR	2014	87	98	210	214	0.070	0.069	0.068	0.068	0	Y
39-027-1002	1	810	Wilmington	Clinton	62 LAUREL DR.	2009	47	96	205	214	0.073	0.072	0.071	0.070	0	
39-027-1002	1	810	Wilmington	Clinton	62 LAUREL DR.	2010	47	99	211	214	0.080	0.077	0.076	0.076	4	
39-027-1002	1	810	Wilmington	Clinton	62 LAUREL DR.	2011	47	99	212	214	0.090	0.087	0.086	0.084	13	
39-027-1002	1	810	Wilmington	Clinton	62 LAUREL DR.	2012	47	100	213	214	0.100	0.091	0.087	0.086	8	Y
39-027-1002	1	810	Wilmington	Clinton	62 LAUREL DR.	2013	47	99	212	214	0.077	0.069	0.065	0.064	1	
39-027-1002	1	810	Wilmington	Clinton	62 LAUREL DR.	2014	47	99	212	214	0.077	0.071	0.070	0.070	1	Y
39-061-0006	1	1259	Cincinnati	Hamilton	11590 GROOMS RD	2009	87	98	209	214	0.080	0.076	0.075	0.072	2	
39-061-0006	1	1259	Cincinnati	Hamilton	11590 GROOMS RD	2010	87	99	212	214	0.092	0.089	0.083	0.080	11	
39-061-0006	1	1259	Cincinnati	Hamilton	11590 GROOMS RD	2011	87	98	209	214	0.093	0.092	0.088	0.088	18	
39-061-0006	1	1259	Cincinnati	Hamilton	11590 GROOMS RD	2012	87	96	206	214	0.098	0.096	0.092	0.087	12	Y
39-061-0006	1	1259	Cincinnati	Hamilton	11590 GROOMS RD	2013	87	95	204	214	0.074	0.070	0.069	0.069	0	
39-061-0006	1	1259	Cincinnati	Hamilton	11590 GROOMS RD	2014	87	96	205	214	0.083	0.072	0.071	0.070	1	Y
39-061-0010	1	1259	Cleves	Hamilton	6950 RIPPLE RD.	2009	87	80	172	214	0.069	0.066	0.065	0.065	0	
39-061-0010	1	1259	Cleves	Hamilton	6950 RIPPLE RD.	2010	87	98	210	214	0.094	0.084	0.083	0.079	5	
39-061-0010	1	1259	Cleves	Hamilton	6950 RIPPLE RD.	2011	87	99	211	214	0.081	0.079	0.078	0.078	7	
39-061-0010	1	1259	Cleves	Hamilton	6950 RIPPLE RD.	2012	87	87	187	214	0.090	0.085	0.085	0.083	12	Y
39-061-0010	1	1259	Cleves	Hamilton	6950 RIPPLE RD.	2013	87	97	208	214	0.073	0.071	0.069	0.064	0	
39-061-0010	1	1259	Cleves	Hamilton	6950 RIPPLE RD.	2014	87	100	213	214	0.076	0.075	0.074	0.073	1	Y
39-061-0040	1	1259	Cincinnati	Hamilton	250 WM. HOWARD TAFT	2009	87	99	211	214	0.077	0.076	0.074	0.074	2	
39-061-0040	1	1259	Cincinnati	Hamilton	250 WM. HOWARD TAFT	2010	87	100	214	214	0.093	0.078	0.077	0.075	3	
39-061-0040	1	1259	Cincinnati	Hamilton	250 WM. HOWARD TAFT	2011	87	100	214	214	0.097	0.089	0.087	0.085	15	
39-061-0040	1	1259	Cincinnati	Hamilton	250 WM. HOWARD TAFT	2012	87	100	213	214	0.096	0.083	0.082	0.082	11	
39-061-0040	1	1259	Cincinnati	Hamilton	250 WM. HOWARD TAFT	2013	87	99	212	214	0.074	0.073	0.072	0.069	0	
39-061-0040	1	1259	Cincinnati	Hamilton	250 WM. HOWARD TAFT	2014	87	100	213	214	0.078	0.074	0.069	0.069	1	Y

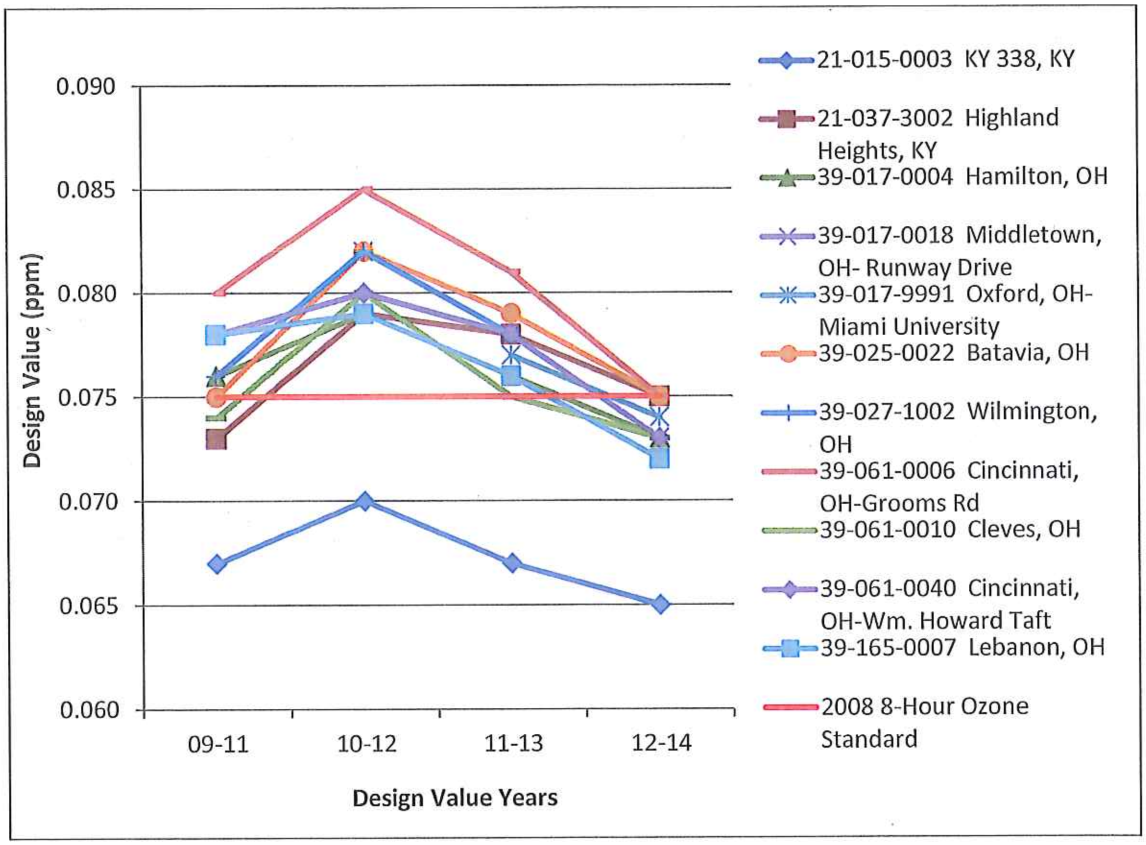
O[illegible]	8-HOUR Ozone (44201)		(PARTS PER MILLION)													
SITE ID	POC	PQAO	CITY	COUNTY	ADDRESS	YEAR	METH	%OBS	VALID DAYS MEAS	NUM DAYS REQ	1ST MAX 8-HR	2ND MAX 8-HR	3RD MAX 8-HR	4TH MAX 8-HR	DAY MAX > 0.075	CERT
39-165-0007	1	1259	Lebanon	Warren	416 SOUTHEAST ST.	2009	87	100	213	214	0.080	0.080	0.078	0.077	4	
39-165-0007	1	1259	Lebanon	Warren	416 SOUTHEAST ST.	2010	87	100	214	214	0.085	0.078	0.077	0.076	4	
39-165-0007	1	1259	Lebanon	Warren	416 SOUTHEAST ST.	2011	87	100	213	214	0.092	0.083	0.083	0.082	10	
39-165-0007	1	1259	Lebanon	Warren	416 SOUTHEAST ST.	2012	87	100	213	214	0.092	0.089	0.084	0.080	5	Y
39-165-0007	1	1259	Lebanon	Warren	416 SOUTHEAST ST.	2013	87	99	212	214	0.074	0.072	0.071	0.067	0	
39-165-0007	1	1259	Lebanon	Warren	416 SOUTHEAST ST.	2014	87	100	213	214	0.074	0.073	0.071	0.071	0	Y

AQS Monitoring Data for the Entire Cincinnati-Hamilton, OH-KY-IN 2008 8-Hour Ozone Nonattainment Area

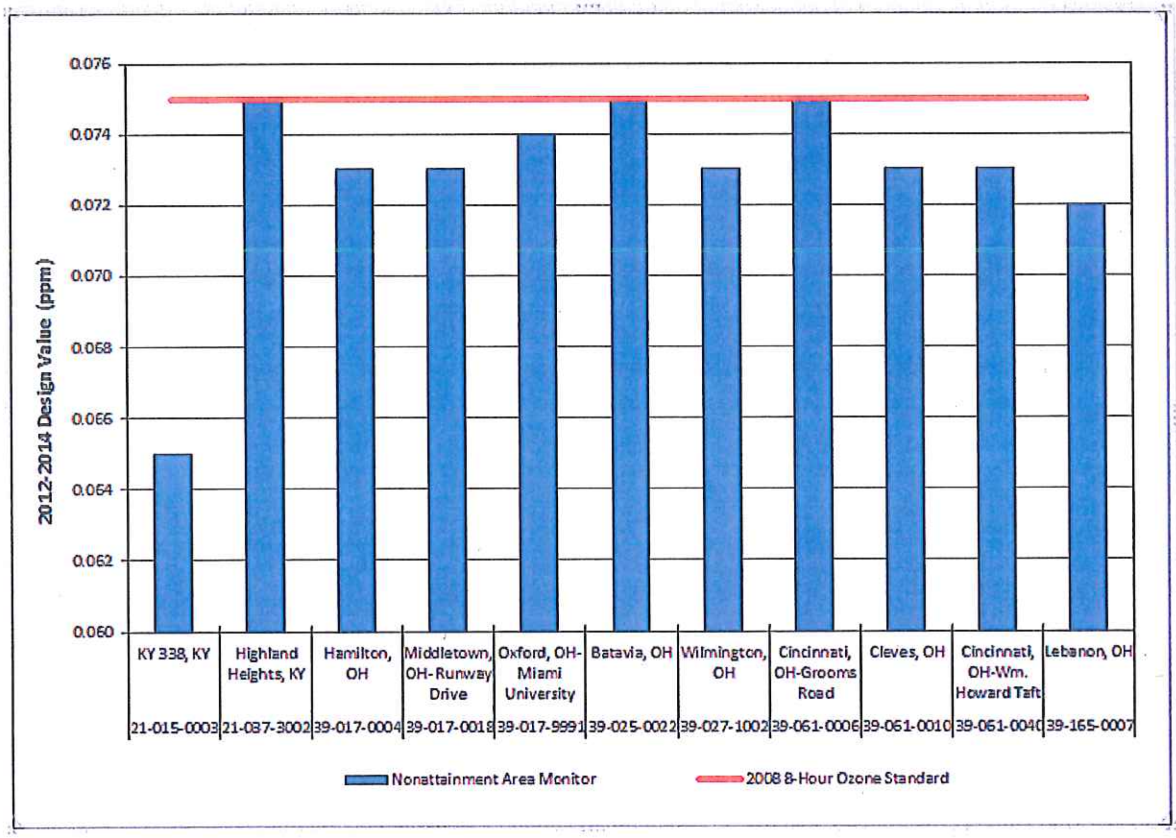
			Annual Fourth High						Design Value			
County	**AQS #**	**Site**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**09-11 avg**	**10-12 avg**	**11-13 avg**	**12-14 avg**
Boone	21-015-0003	KY 338, KY	0.064	0.067	0.070	0.074	0.059	0.062	0.067	0.070	0.067	0.065
Campbell	21-037-3002	Highland Heights, KY	0.068	0.073	0.080	0.084	0.072	0.071	0.073	0.079	0.078	0.075
Kenton	21-117-0007	Covington, KY	0.074	0.064*								
Butler	39-017-0004	Hamilton, OH	0.073	0.077	0.078	0.083	0.068	0.070	0.076	0.079	0.076	0.073
Butler	39-017-1004	Middletown, OH- Hook Field Municipal Airport	0.076*									
Butler	39-017-0018	Middletown, OH-Runway Drive		0.080	0.082	0.084	0.068	0.069		0.082	0.078	0.073
Butler	39-017-9991	Oxford, OH-Miami University			0.079	0.085	0.069	0.069			0.077	0.074
Clermont	39-025-0022	Batavia, OH	0.069	0.075	0.082	0.091	0.066	0.068	0.075	0.082	0.079	0.075
Clinton	39-027-1002	Wilmington, OH	0.070	0.076	0.084	0.086	0.064	0.070	0.076	0.082	0.078	0.073
Hamilton	39-061-0006	Cincinnati, OH-Grooms Road	0.072	0.080	0.088	0.087	0.069	0.070	0.080	0.085	0.081	0.075
Hamilton	39-061-0010	Cleves, OH	0.065	0.079	0.078	0.083	0.064	0.073	0.074	0.080	0.075	0.073
Hamilton	39-061-0040	Cincinnati, OH-Wm. Howard Taft	0.074	0.075	0.085	0.082	0.069	0.069	0.078	0.080	0.078	0.073
Warren	39-165-0007	Lebanon, OH	0.077	0.076	0.082	0.080	0.067	0.071	0.078	0.079	0.076	0.072

*Monitor discontinued mid-year.
Indicates values are > 0.075 ppm.

2009-2014 Design Values for the Cincinnati-Hamilton, OH-KY-IN 2008 8-Hour Nonattainment Area



Design Value Trends in the Cincinnati-Hamilton, OH-KY-IN 2008 8-Hour Ozone Nonattainment Area, 2012-2014



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APPENDIX B

Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOC) Point Source Emissions, 2011 and 2014, for Dearborn County, Indiana and Entire Cincinnati-Hamilton, OH-KY-IN Nonattainment Area

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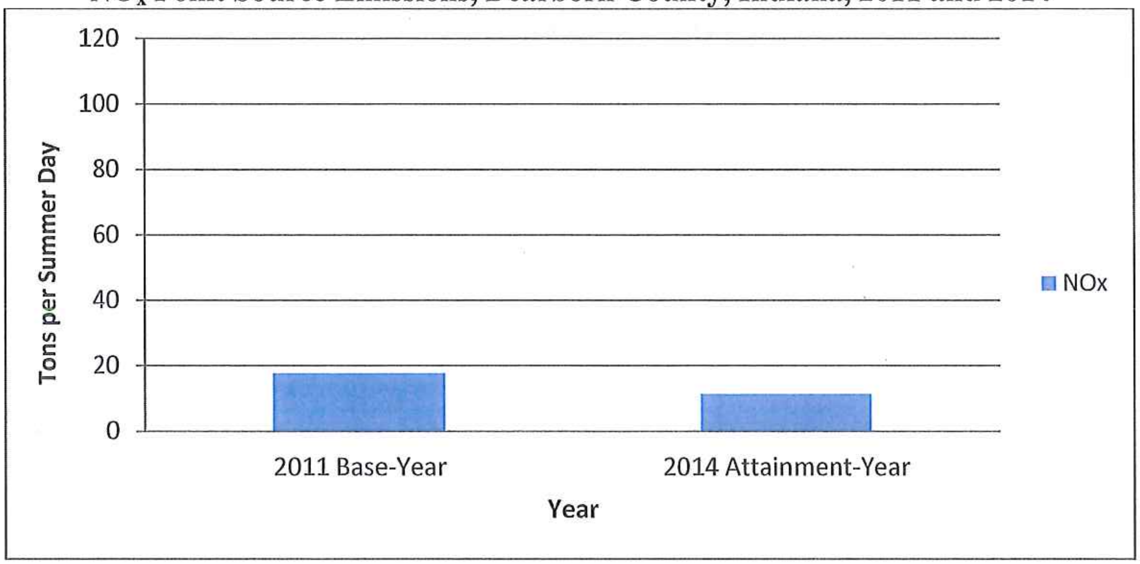
Dearborn County, Indiana Point Source Emission Totals (Tons per Summer Day)		
Year	**NO_x**	**VOC**
2011	17.79	4.28
2014	11.44	4.19

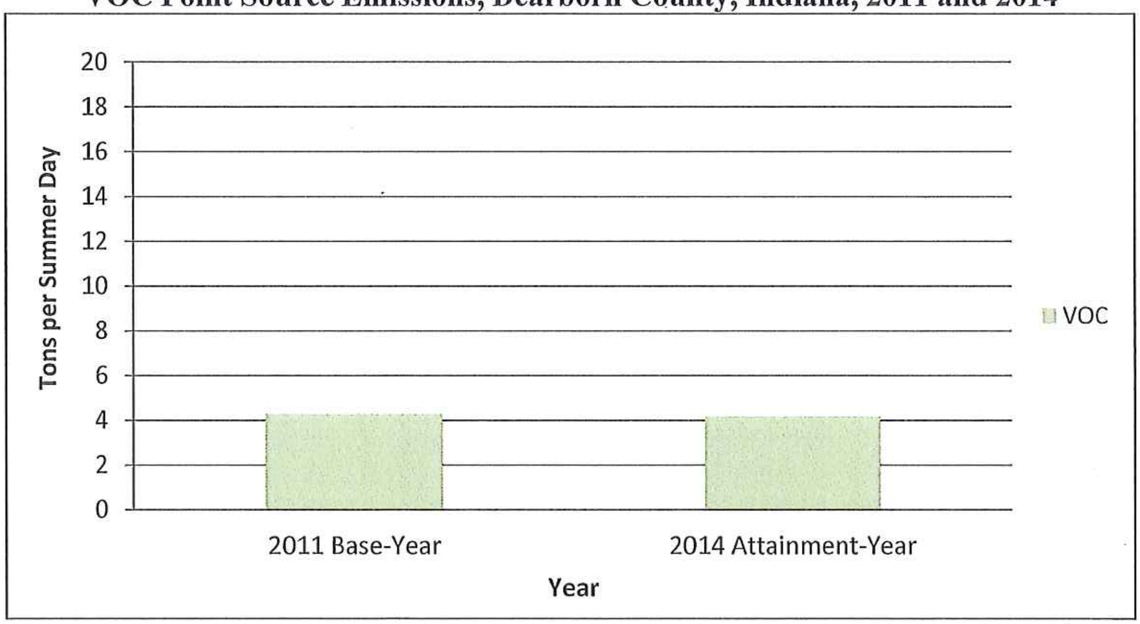
2011-Dearborn County, Indiana Point Source Emission Totals (Tons per Summer Day)				
County	**EGU-NO_x**	**NON-EGU-NO_x**	**EGU-VOC**	**NON-EGU-VOC**
Dearborn	15.08	2.71	0.27	4.01
	Total NO_x	**17.79**	**Total VOC**	**4.28**

2014-Dearborn County, Indiana Point Source Emission Totals (Tons per Summer Day)				
County	**EGU-NO_x**	**NON-EGU-NO_x**	**EGU-VOC**	**NON-EGU-VOC**
Dearborn	8.73	2.71	0.18	4.01
	Total NO_x	**11.44**	**Total VOC**	**4.19**

NO_x Point Source Emissions, Dearborn County, Indiana, 2011 and 2014



VOC Point Source Emissions, Dearborn County, Indiana, 2011 and 2014

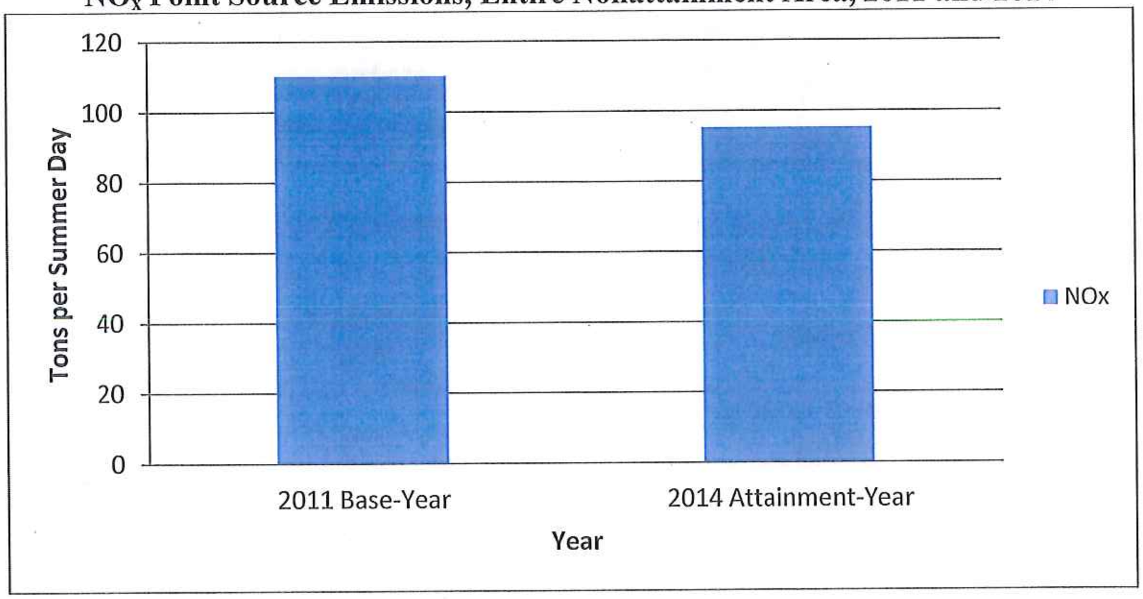


Cincinnati Area Point Source Emission Totals (Tons per Summer Day)		
Year	NO_x	VOC
2011	110.23	15.04
2014	95.29	14.80

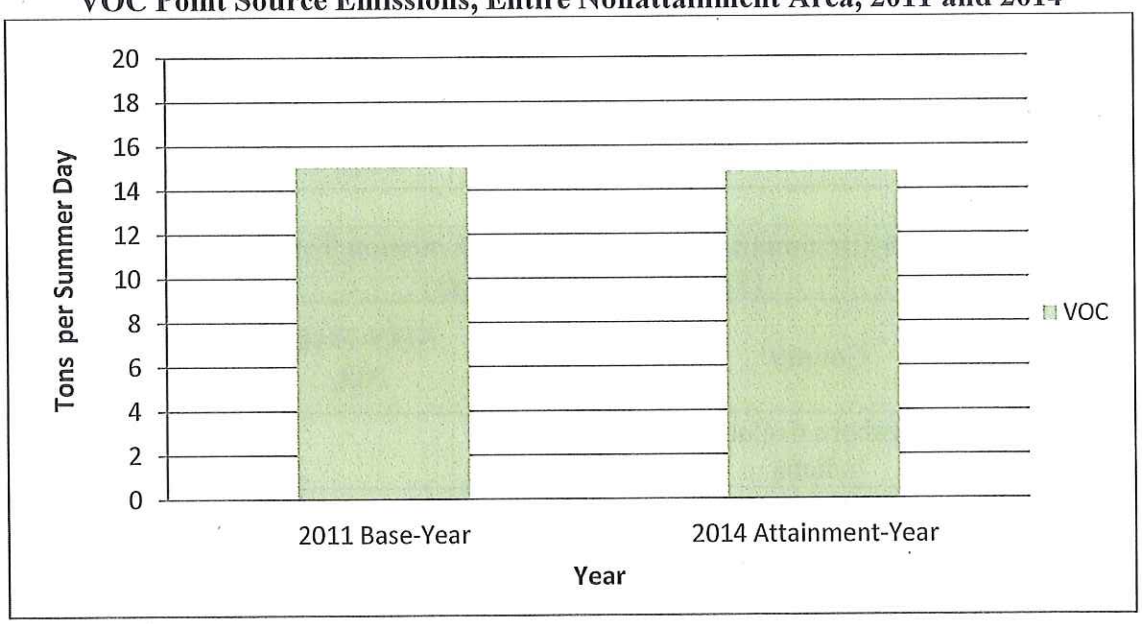
2011-Cincinnati Area Point Source Emission Totals (Tons per Summer Day)					
State	County	EGU-NO_x	NON-EGU-NO_x	EGU-VOC	NON-EGU-VOC
Indiana	Dearborn County, Indiana	15.08	2.71	0.27	4.01
Kentucky	Boone	7.48	2.23	0.29	2.48
Kentucky	Campbell	0.00	0.23	0.00	0.44
Kentucky	Kenton	0.00	0.40	0.00	0.63
Ohio	Butler	1.12	9.57	0.03	3.09
Ohio	Clermont	43.41	0.14	0.28	0.22
Ohio	Clinton	0.00	0.00	0.00	0.01
Ohio	Hamilton	17.72	8.59	0.26	2.40
Ohio	Warren	0.00	1.55	0.00	0.63
	Total NO_x	110.23	Total VOC	15.04	

2014-Cincinnati Area Point Source Emission Totals (Tons per Summer Day)					
State	County	EGU-NO_x	NON-EGU-NO_x	EGU-VOC	NON-EGU-VOC
Indiana	Dearborn County, Indiana	8.73	2.71	0.18	4.01
Kentucky	Boone	7.73	2.26	0.28	2.45
Kentucky	Campbell	0.00	0.23	0.00	0.44
Kentucky	Kenton	0.00	0.40	0.00	0.63
Ohio	Butler	0.73	9.58	0.02	3.05
Ohio	Clermont	38.17	0.14	0.28	0.22
Ohio	Clinton	0.00	0.00	0.00	0.01
Ohio	Hamilton	14.47	8.59	0.23	2.39
Ohio	Warren	0.00	1.55	0.00	0.63
	Total NO_x	95.29	Total VOC	14.80	

NO_x Point Source Emissions, Entire Nonattainment Area, 2011 and 2014



VOC Point Source Emissions, Entire Nonattainment Area, 2011 and 2014



APPENDIX C

Nitrogen Oxides (NO_x) Emissions from Electric Generating Units for Lawrenceburg Township, Dearborn County, Indiana and Entire Cincinnati-Hamilton, OH-KY-IN, Nonattainment Area, 2003 – 2014

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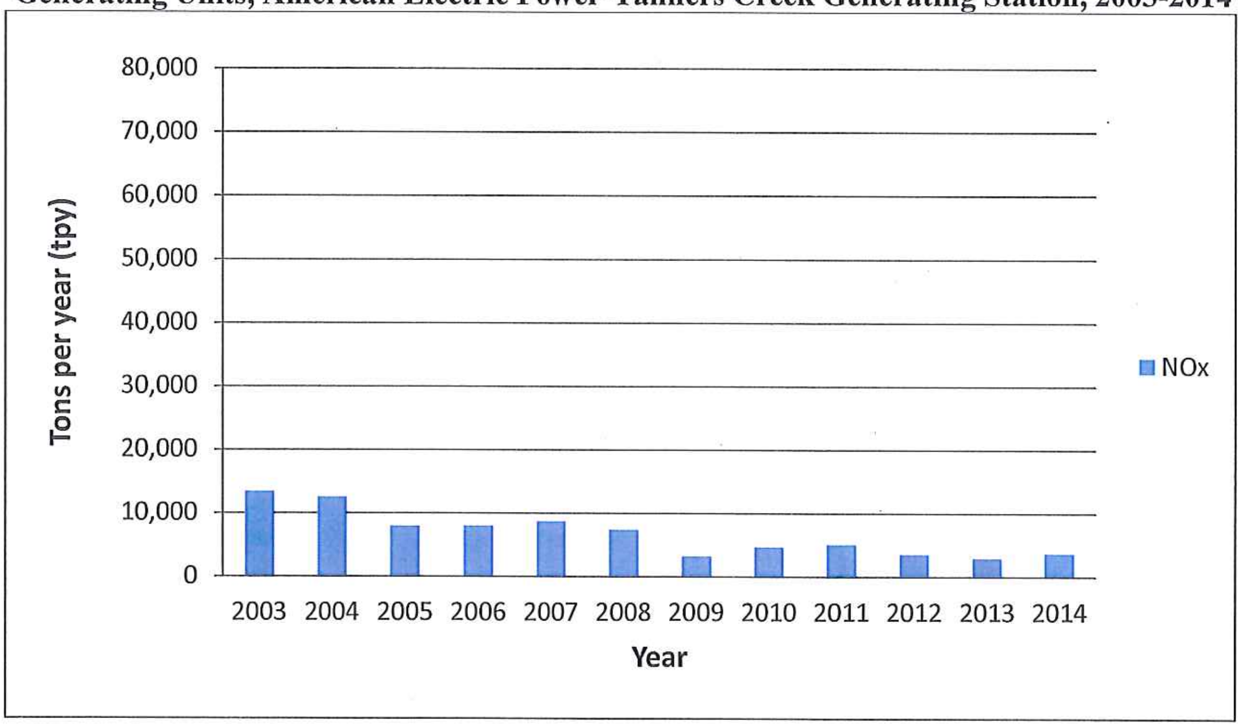
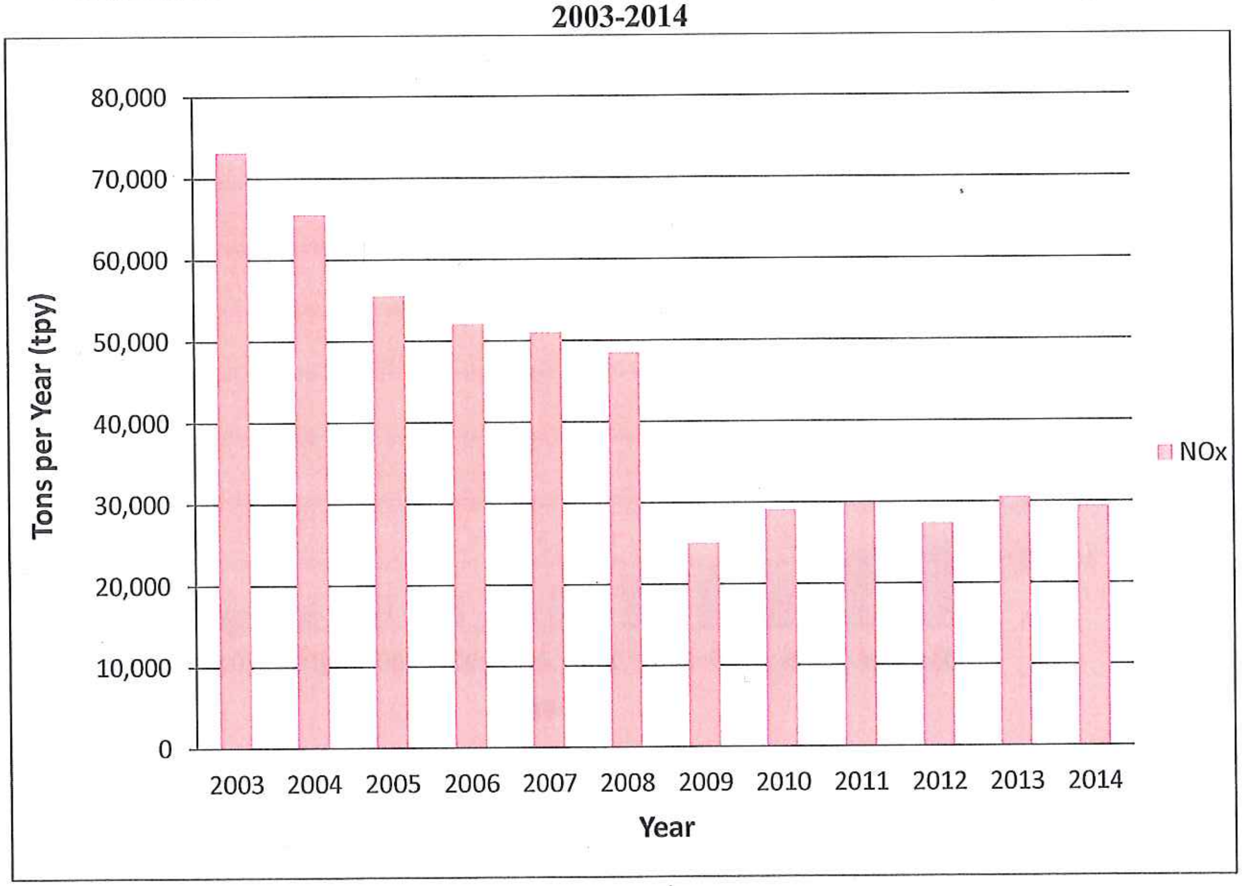
NO_x Emissions from Lawrenceburg Township, Dearborn County, Indiana Electric Generating Units, American Electric Power-Tanners Creek Generating Station, 2003-2014	
Year	**Total NO_x Emissions, Tons per Year**
2003	13,417.00
2004	12,553.00
2005	7,961.00
2006	8,042.00
2007	8,739.00
2008	7,429.00
2009	3,259.00
2010	4,676.00
2011	5,095.00
2012	3,519.00
2013	2,949.00
2014	3,699.00

NO_x Emissions from Lawrenceburg Township, Dearborn County, Indiana Electric Generating Units, American Electric Power-Tanners Creek Generating Station, 2003-2014



NO$_x$ Emissions from EGUs - Entire Nonattainment Area, 2003-2014	
Year	**Total NO$_x$ Emissions, Tons per Year**
2003	73,135.00
2004	65,517.00
2005	55,538.00
2006	52,039.00
2007	51,002.00
2008	48,494.00
2009	25,008.00
2010	29,070.00
2011	29,908.00
2012	27,389.00
2013	30,576.00
2014	29,417.00

NO$_x$ Emissions from EGUs – Entire Nonattainment Area Electric Generating Units, 2003-2014



APPENDIX D

Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOC) Emissions, All Sources, 2011 and 2014, for Dearborn County Indiana and Entire Cincinnati-Hamilton, OH-KY-IN Nonattainment Area

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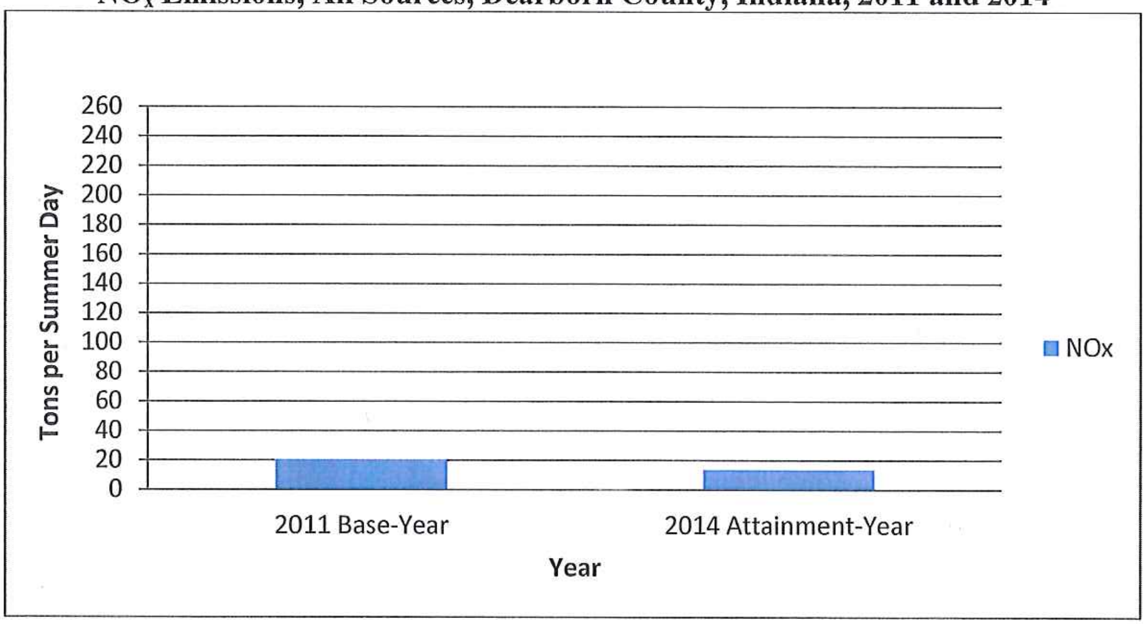
Dearborn County, Indiana, Emission Totals, All Sources (Tons per Summer Day)		
Year	**NO_x**	**VOC**
2011	20.68	7.78
2014	13.72	7.29

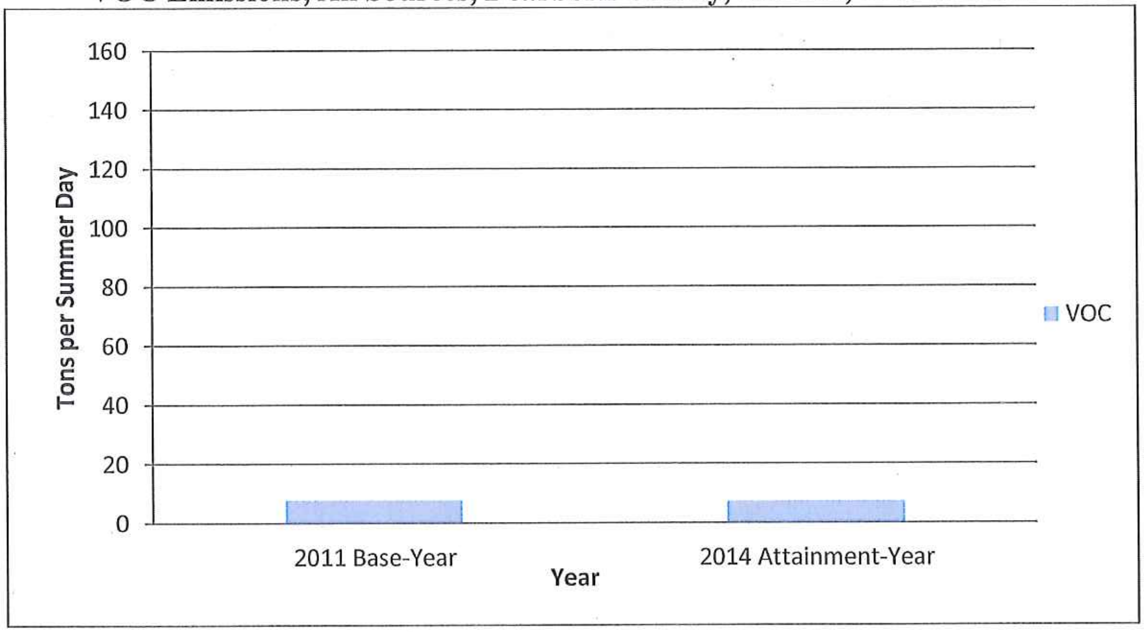
2011-Dearborn County, Indiana Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU Point**	**EGU-Point**	**Total**
NO_x	0.47	0.53	1.89	2.71	15.08	20.68
VOC	1.75	0.42	1.33	4.01	0.27	7.78

2014-Dearborn County, Indiana Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU Point**	**EGU-Point**	**Total**
NO_x	0.47	0.44	1.37	2.71	8.73	13.72
VOC	1.75	0.36	0.99	4.01	0.18	7.29

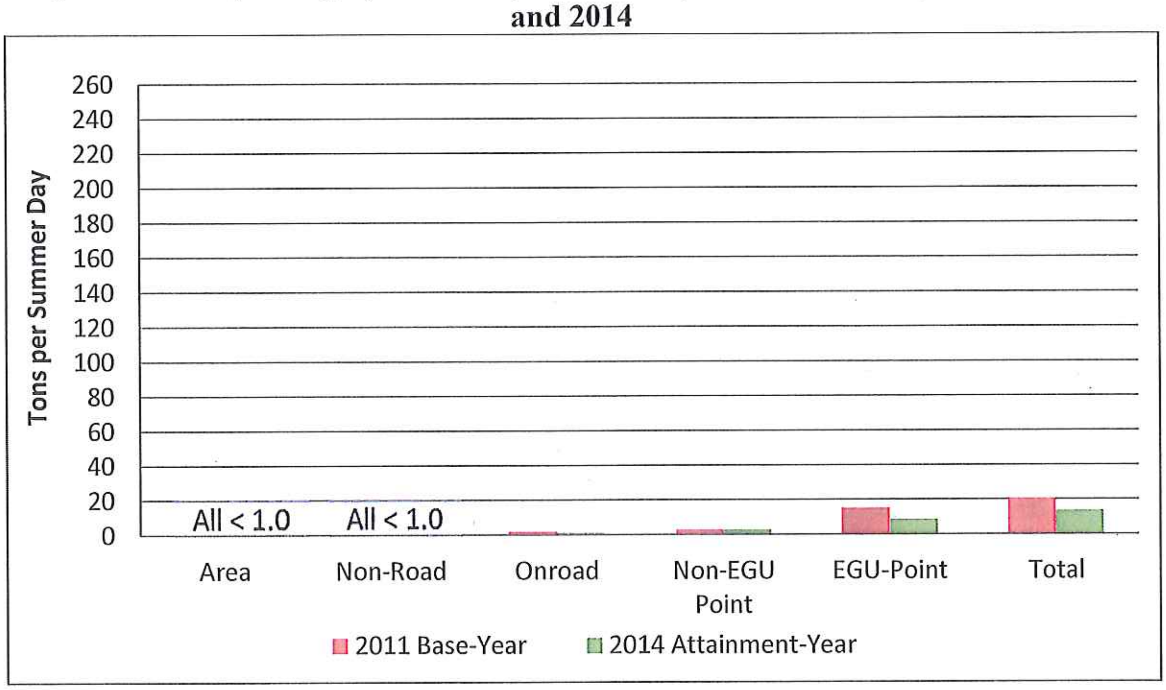
NO_x Emissions, All Sources, Dearborn County, Indiana, 2011 and 2014



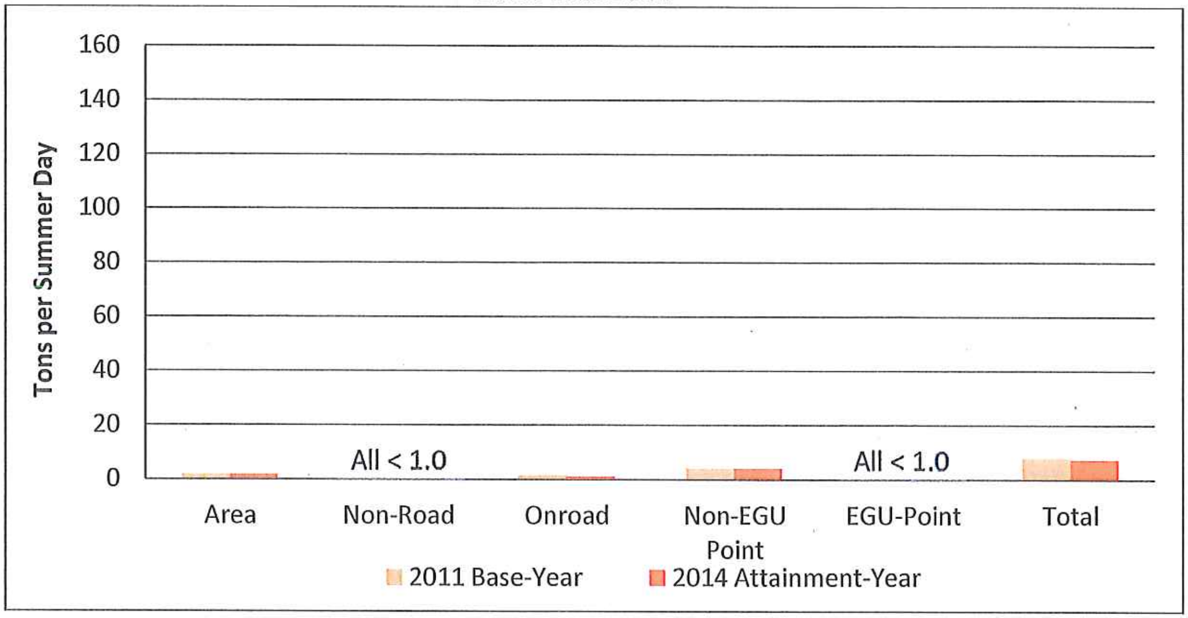
VOC Emissions, All Sources, Dearborn County, Indiana, 2011 and 2014



NO_x Emissions by Category and Year, All Sources, Dearborn County, Indiana, 2011 and 2014



VOC Emissions by Category and Year, All Sources, Dearborn County, Indiana, 2011 and 2014

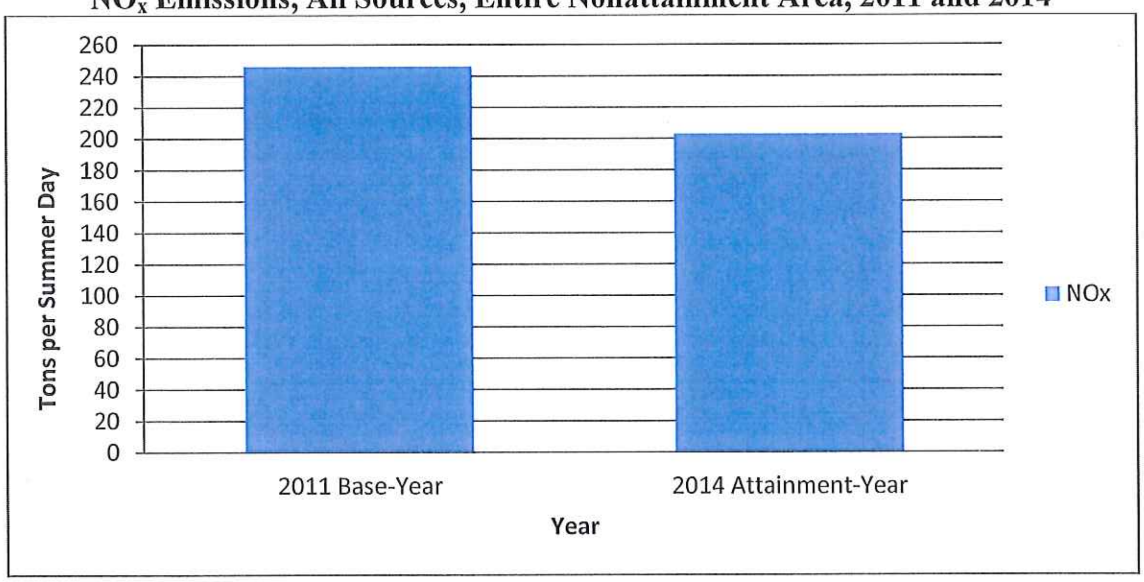


Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)		
Year	NO_x	VOC
2011	245.99	159.45
2014	203.10	139.26

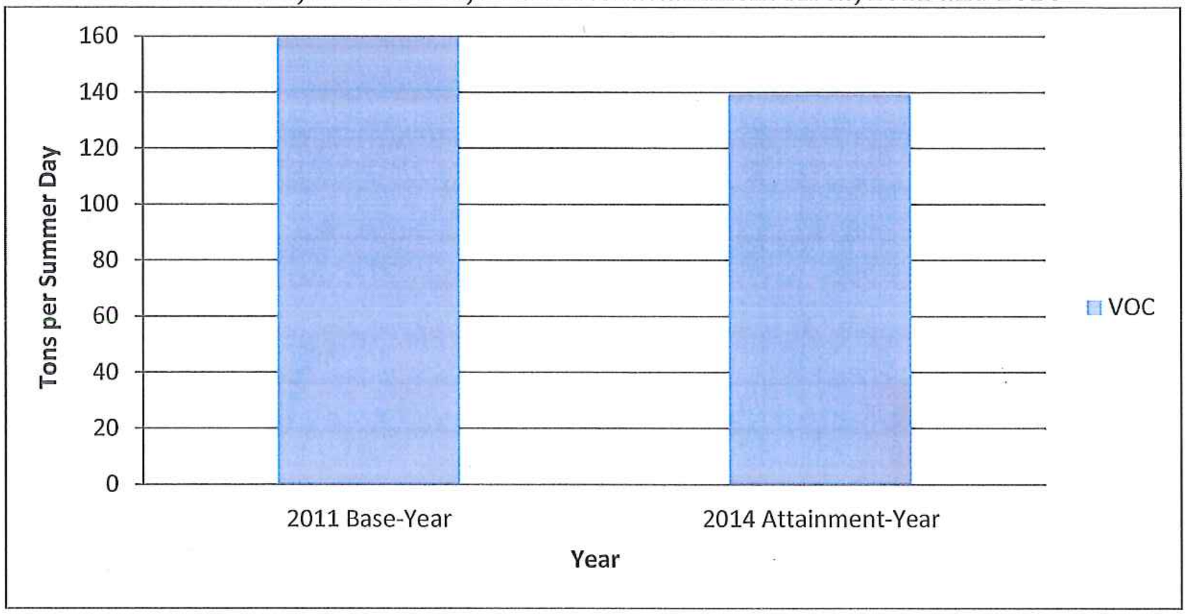
2011- Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)						
	Area	Nonroad	Onroad	Non-EGU Point	EGU-Point	Total
NO_x	22.17	23.96	89.63	25.42	84.81	245.99
VOC	58.44	20.14	65.83	13.92	1.12	159.45

2014 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)						
	Area	Nonroad	Onroad	Non-EGU Point	EGU-Point	Total
NO_x	22.16	19.20	66.44	25.46	69.83	203.10
VOC	57.68	17.77	49.00	13.82	0.99	139.26

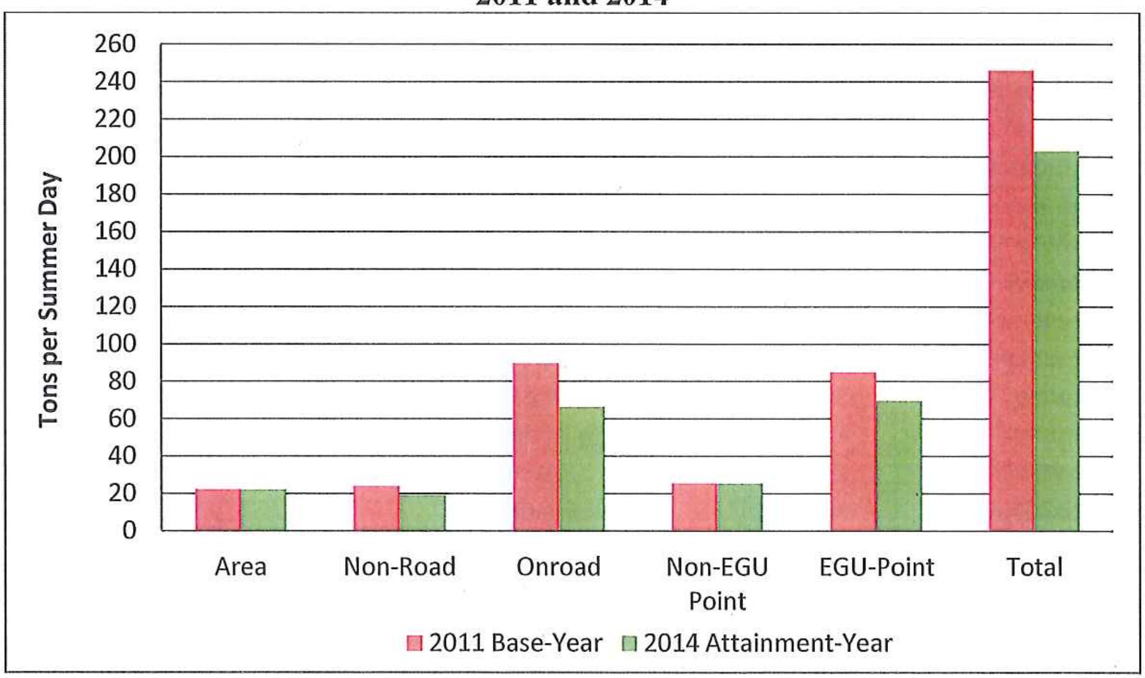
NO_x Emissions, All Sources, Entire Nonattainment Area, 2011 and 2014



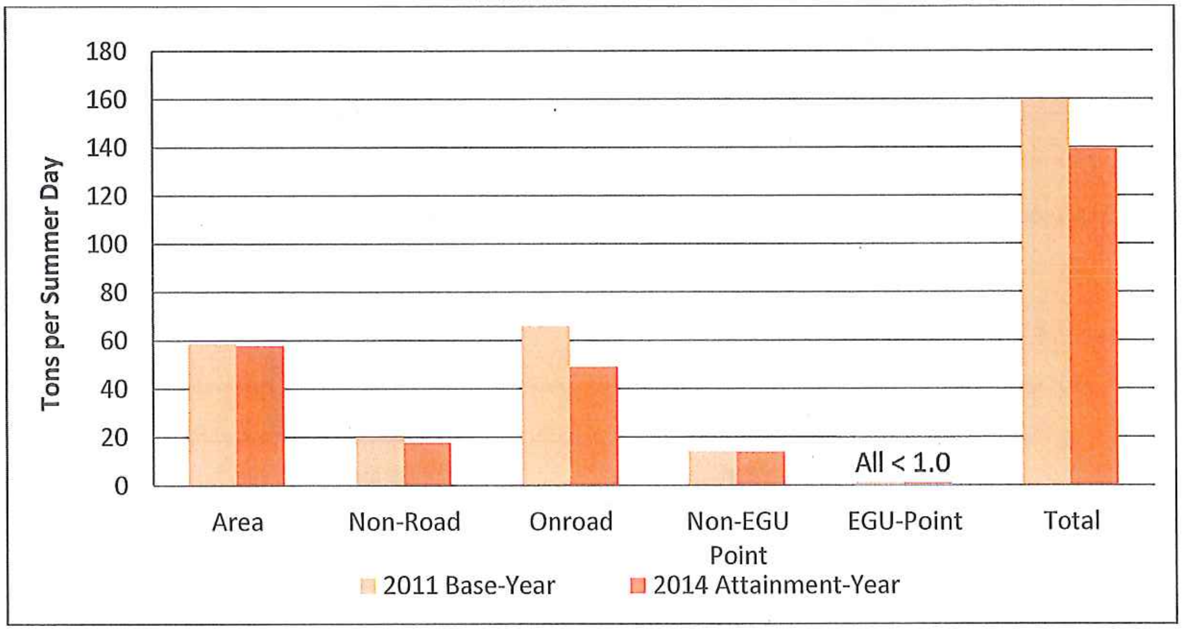
VOC Emissions, All Sources, Entire Nonattainment Area, 2011 and 2014



NO_x Emissions by Category and Year, All Sources, Entire Nonattainment Area, 2011 and 2014



VOC Emissions by Category and Year, All Sources, Entire Nonattainment Area, 2011 and 2014



2011 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)				
State	**County**	**Sector**	**NO_x**	**VOC**
Indiana	Dearborn	Area	0.47	1.75
Indiana	Dearborn	Nonroad	0.53	0.42
Indiana	Dearborn	Onroad	1.89	1.33
Indiana	Dearborn	EGU-Point	15.08	0.27
Indiana	Dearborn	Non-EGU-Point	2.71	4.01
Kentucky	Boone	Area	0.76	4.66
Kentucky	Boone	Nonroad	1.85	2.61
Kentucky	Boone	Onroad	7.75	3.68
Kentucky	Boone	EGU-Point	7.48	0.29
Kentucky	Boone	Non-EGU-Point	2.23	2.48
Kentucky	Campbell	Area	0.87	2.31
Kentucky	Campbell	Nonroad	0.67	0.70
Kentucky	Campbell	Onroad	4.83	2.29
Kentucky	Campbell	EGU-Point	0.00	0.00
Kentucky	Campbell	Non-EGU-Point	0.23	0.44
Kentucky	Kenton	Area	1.88	4.64
Kentucky	Kenton	Nonroad	1.42	1.14
Kentucky	Kenton	Onroad	7.34	3.48
Kentucky	Kenton	EGU-Point	0.00	0.00
Kentucky	Kenton	Non-EGU-Point	0.40	0.63
Ohio	Butler	Area	4.78	9.59
Ohio	Butler	Nonroad	4.27	2.93
Ohio	Butler	Onroad	12.24	10.21
Ohio	Butler	EGU-Point	1.12	0.03

2011 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)				
State	**County**	**Sector**	**NO_x**	**VOC**
Ohio	Butler	Non-EGU-Point	9.57	3.09
Ohio	Clermont	Area	1.14	5.41
Ohio	Clermont	Nonroad	2.27	1.95
Ohio	Clermont	Onroad	7.52	6.27
Ohio	Clermont	EGU-Point	43.41	0.28
Ohio	Clermont	Non-EGU-Point	0.14	0.22
Ohio	Clinton	Area	0.52	2.49
Ohio	Clinton	Nonroad	1.15	0.84
Ohio	Clinton	Onroad	4.53	2.27
Ohio	Clinton	EGU-Point	0.00	0.00
Ohio	Clinton	Non-EGU-Point	0.00	0.01
Ohio	Hamilton	Area	10.09	21.88
Ohio	Hamilton	Nonroad	8.56	7.44
Ohio	Hamilton	Onroad	33.69	28.09
Ohio	Hamilton	EGU-Point	17.72	0.26
Ohio	Hamilton	Non-EGU-Point	8.59	2.40
Ohio	Warren	Area	1.66	5.71
Ohio	Warren	Nonroad	3.24	2.12
Ohio	Warren	Onroad	9.84	8.21
Ohio	Warren	EGU-Point	0.00	0.00
Ohio	Warren	Non-EGU-Point	1.55	0.63

2014 Cincinnati Area Totals, All Sources (Tons per Summer Day)				
State	County	Sector	NO_x	VOC
Indiana	Dearborn	Area	0.47	1.75
Indiana	Dearborn	Nonroad	0.44	0.36
Indiana	Dearborn	Onroad	1.37	0.99
Indiana	Dearborn	EGU-Point	8.73	0.18
Indiana	Dearborn	Non-EGU-Point	2.71	4.01
Kentucky	Boone	Area	0.76	4.48
Kentucky	Boone	Nonroad	1.54	2.28
Kentucky	Boone	Onroad	6.14	2.82
Kentucky	Boone	EGU-Point	7.73	0.28
Kentucky	Boone	Non-EGU-Point	2.26	2.45
Kentucky	Campbell	Area	0.87	2.25
Kentucky	Campbell	Nonroad	0.57	0.60
Kentucky	Campbell	Onroad	3.83	1.76
Kentucky	Campbell	EGU-Point	0.00	0.00
Kentucky	Campbell	Non-EGU-Point	0.23	0.44
Kentucky	Kenton	Area	1.88	4.50
Kentucky	Kenton	Nonroad	1.18	1.01
Kentucky	Kenton	Onroad	5.81	2.67
Kentucky	Kenton	EGU-Point	0.00	0.00
Kentucky	Kenton	Non-EGU-Point	0.40	0.63
Ohio	Butler	Area	4.78	9.51
Ohio	Butler	Nonroad	3.39	2.61
Ohio	Butler	Onroad	8.85	7.59
Ohio	Butler	EGU-Point	0.73	0.02
Ohio	Butler	Non-EGU-Point	9.58	3.05
Ohio	Clermont	Area	1.14	5.36
Ohio	Clermont	Nonroad	1.81	1.73
Ohio	Clermont	Onroad	5.44	4.66
Ohio	Clermont	EGU-Point	38.17	0.28
Ohio	Clermont	Non-EGU-Point	0.14	0.22
Ohio	Clinton	Area	0.52	2.51
Ohio	Clinton	Nonroad	0.96	0.71
Ohio	Clinton	Onroad	3.51	1.53
Ohio	Clinton	EGU-Point	0.00	0.00
Ohio	Clinton	Non-EGU-Point	0.00	0.01
Ohio	Hamilton	Area	10.08	21.66
Ohio	Hamilton	Nonroad	6.76	6.54
Ohio	Hamilton	Onroad	24.37	20.88
Ohio	Hamilton	EGU-Point	14.47	0.23
Ohio	Hamilton	Non-EGU-Point	8.59	2.39
Ohio	Warren	Area	1.66	5.66
Ohio	Warren	Nonroad	2.55	1.93
Ohio	Warren	Onroad	7.12	6.10

2014 Cincinnati Area Totals, All Sources (Tons per Summer Day)				
State	**County**	**Sector**	**NO_x**	**VOC**
Ohio	Warren	EGU-Point	0.00	0.00
Ohio	Warren	Non-EGU-Point	1.55	0.63

APPENDIX E

2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) Emission Inventories for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOC), All Sources, for Dearborn County, Indiana, and Entire Cincinnati-Hamilton, OH-KY-IN Nonattainment Area

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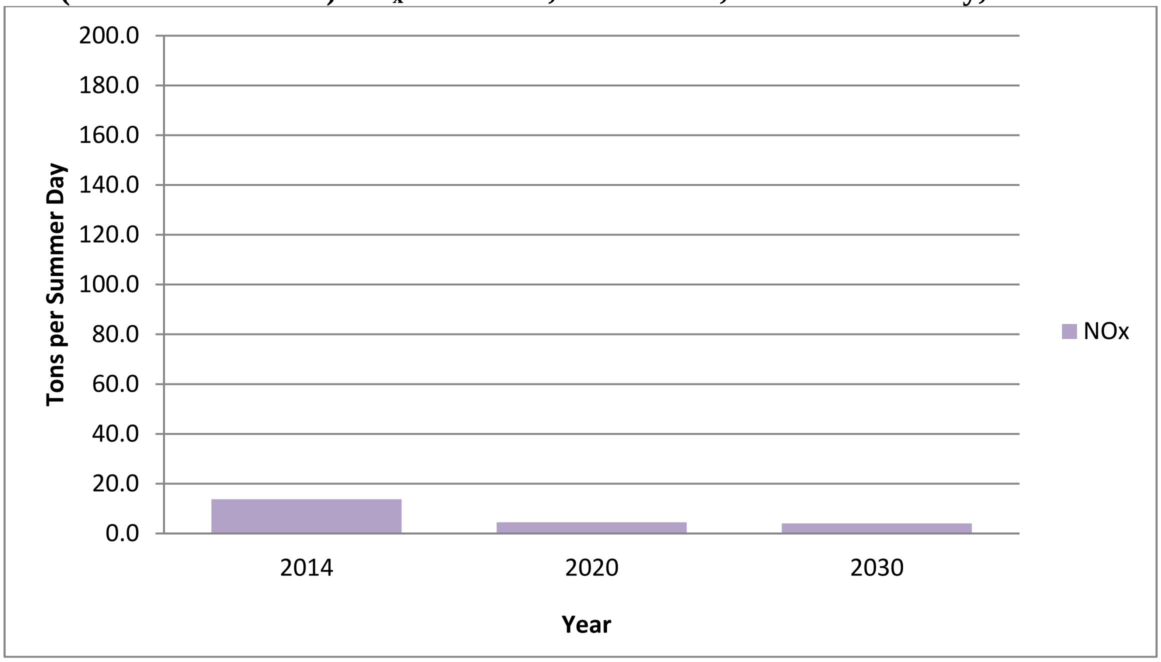
Dearborn County, Indiana, Emission Totals, All Sources (Tons per Summer Day)		
Year	**NO_x**	**VOC**
2014	13.72	7.29
2020	4.48	6.73
2030	4.01	6.55
Difference from 2014 to 2030	**-9.71**	**-0.74**

2014 Dearborn County, Indiana Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU-Point**	**EGU-Point**	**Total**
NO_x	0.47	0.44	1.37	2.71	8.73	13.72
VOC	1.75	0.36	0.99	4.01	0.18	7.29

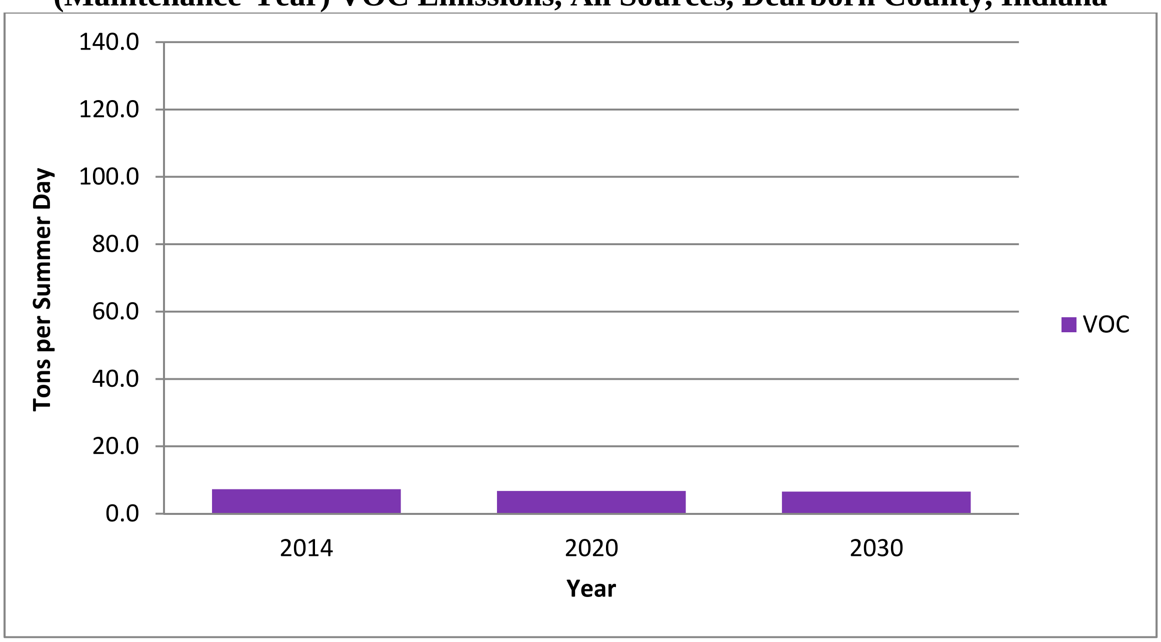
2020 Dearborn County, Indiana Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU-Point**	**EGU-Point**	**Total**
NO_x	0.48	0.30	0.74	2.70	0.26	4.48
VOC	1.77	0.29	0.62	4.01	0.05	6.73

2030 Dearborn County, Indiana Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU-Point**	**EGU-Point**	**Total**
NO_x	0.48	0.18	0.39	2.70	0.26	4.01
VOC	1.85	0.27	0.38	4.01	0.05	6.55

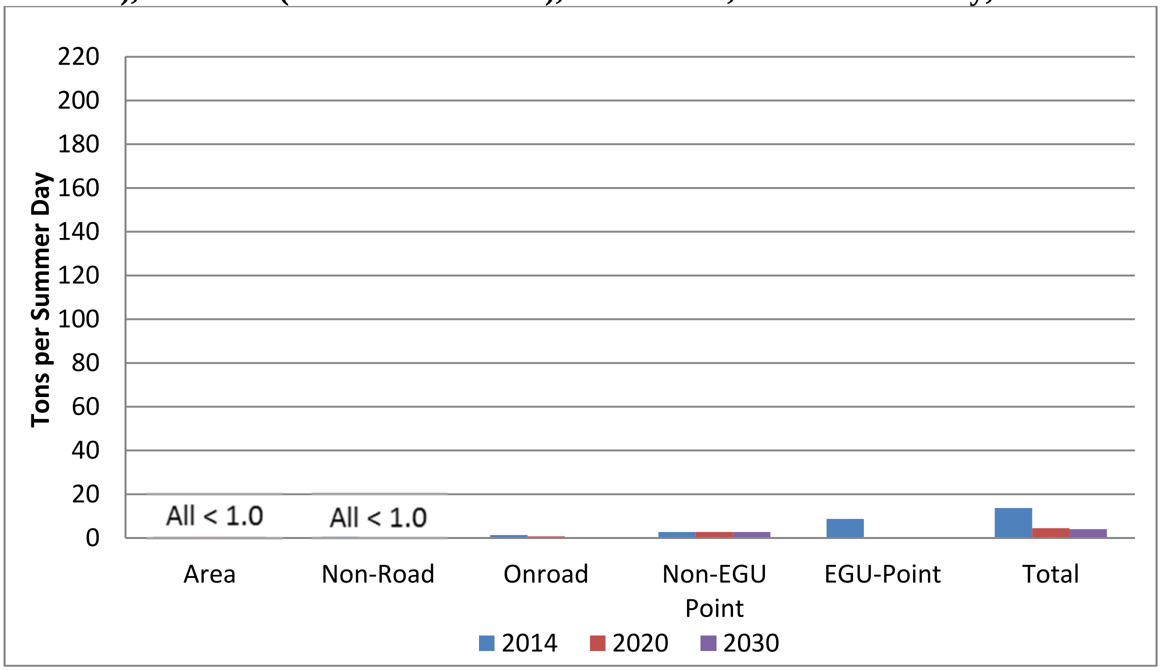
Comparison of 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) NO_x Emissions, All Sources, Dearborn County, Indiana



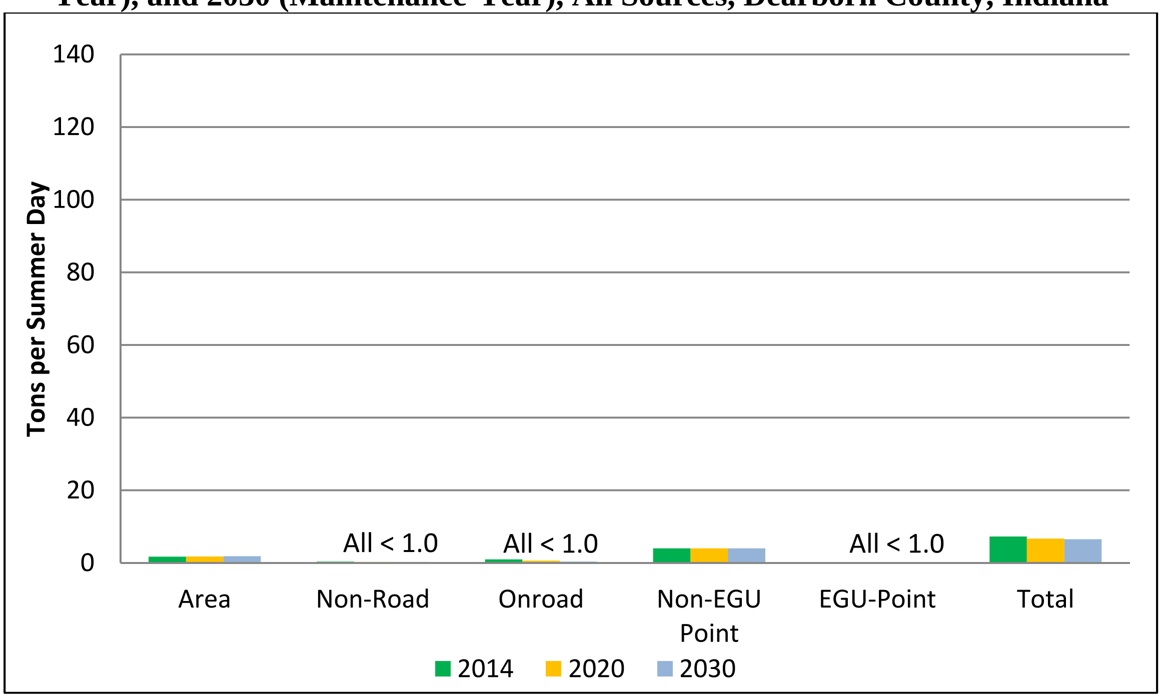
Comparison of 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) VOC Emissions, All Sources, Dearborn County, Indiana



NO_x Emissions by Category and Year, 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year), All Sources, Dearborn County, Indiana



VOC Emissions by Category and Year, 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year), All Sources, Dearborn County, Indiana



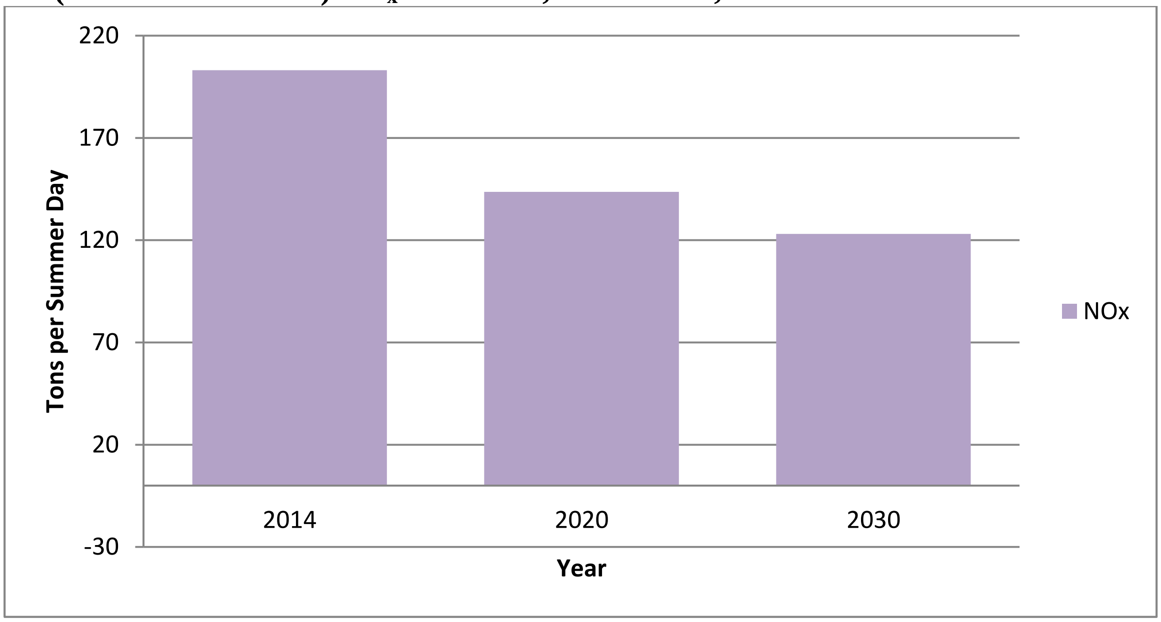
Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)		
Year	**NO_x**	**VOC**
2014	203.10	139.26
2020	143.67	115.87
2030	123.06	103.69
Difference from 2014 to 2030	**-80.04**	**-35.57**

2014 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU Point**	**EGU-Point**	**Total**
NO_x	22.16	19.20	66.44	25.46	69.83	203.10
VOC	57.68	17.77	49.00	13.82	0.99	139.26

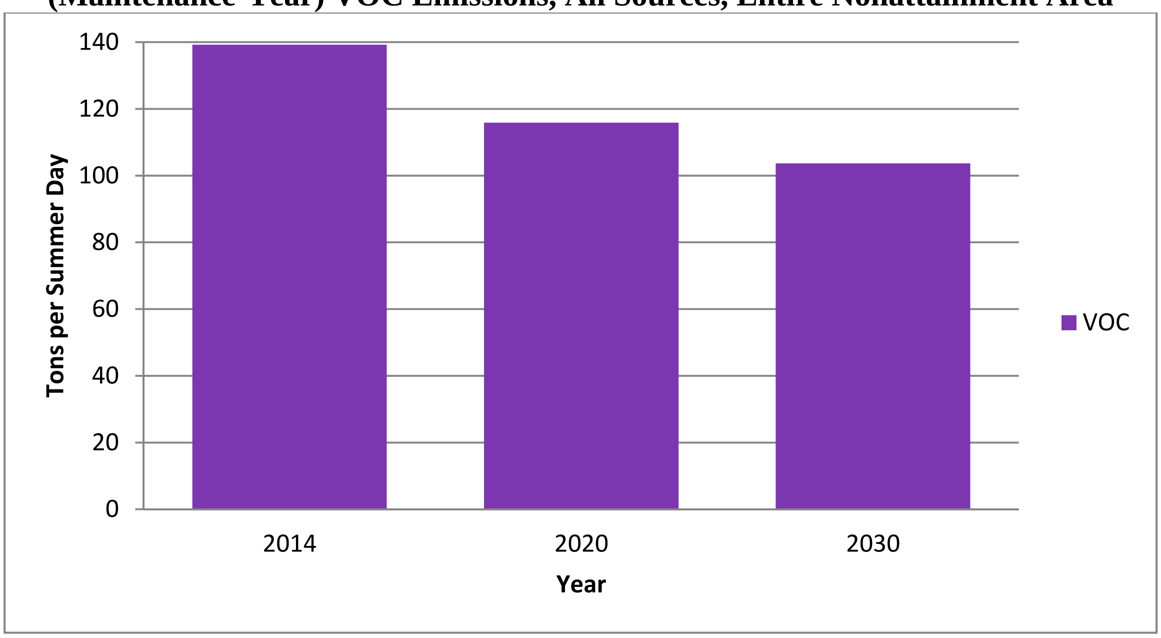
2020 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU Point**	**EGU-Point**	**Total**
NO_x	22.17	11.89	34.08	25.65	49.88	143.67
VOC	56.53	14.53	30.27	13.69	0.85	115.87

2030 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)						
	Area	**Nonroad**	**Onroad**	**Non-EGU Point**	**EGU-Point**	**Total**
NO_x	22.24	7.06	17.32	26.52	49.93	123.06
VOC	55.92	14.87	18.20	13.69	1.02	103.69

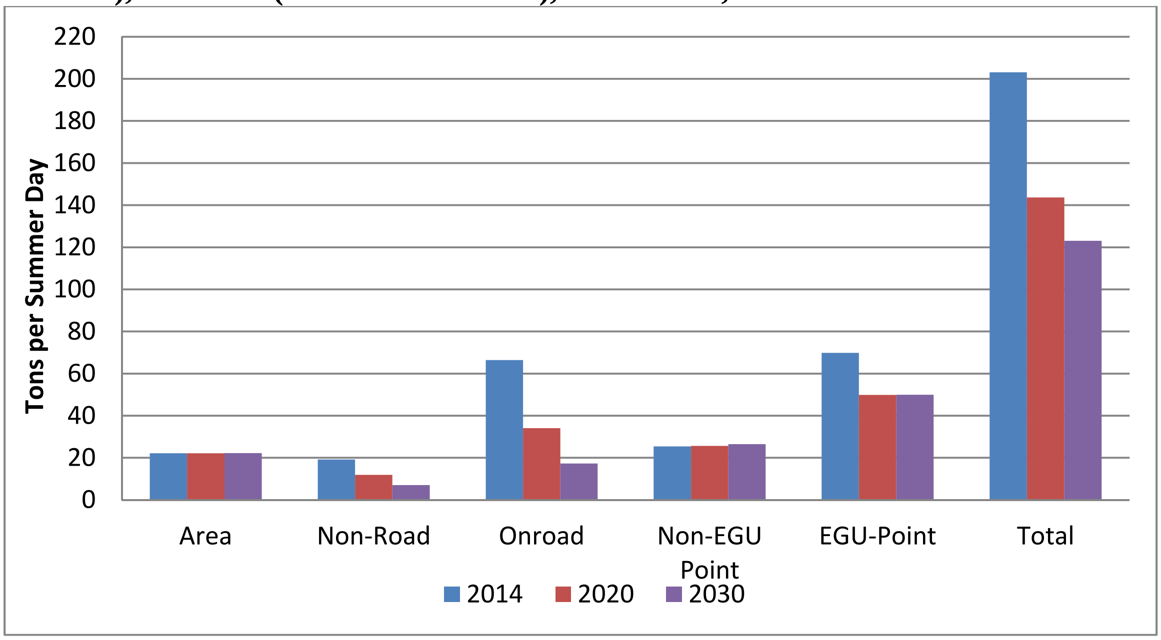
Comparison of 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) NO_x Emissions, All Sources, Entire Nonattainment Area



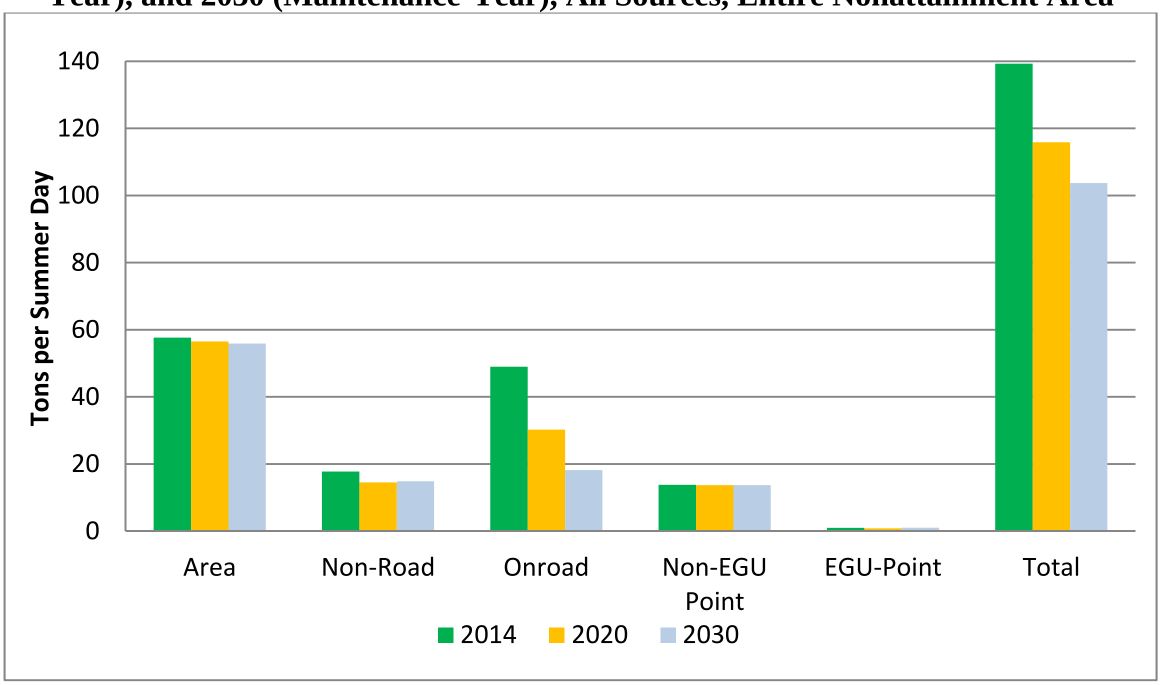
Comparison of 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) VOC Emissions, All Sources, Entire Nonattainment Area



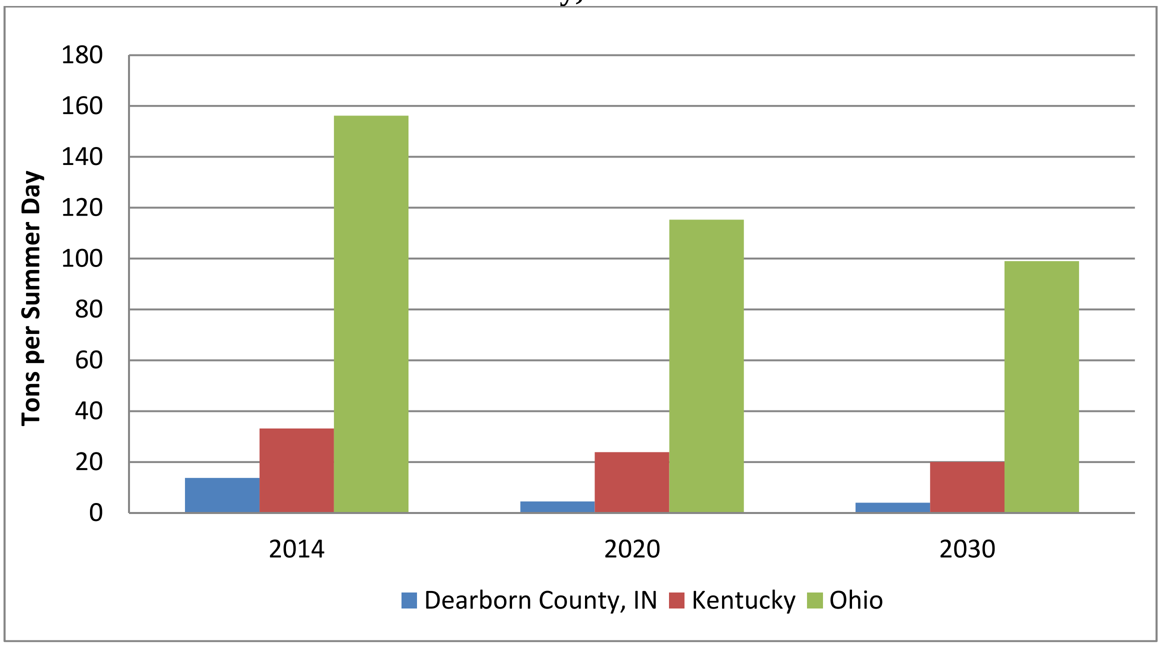
NO_x Emissions by Category and Year, 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year), All Sources, Entire Nonattainment Area



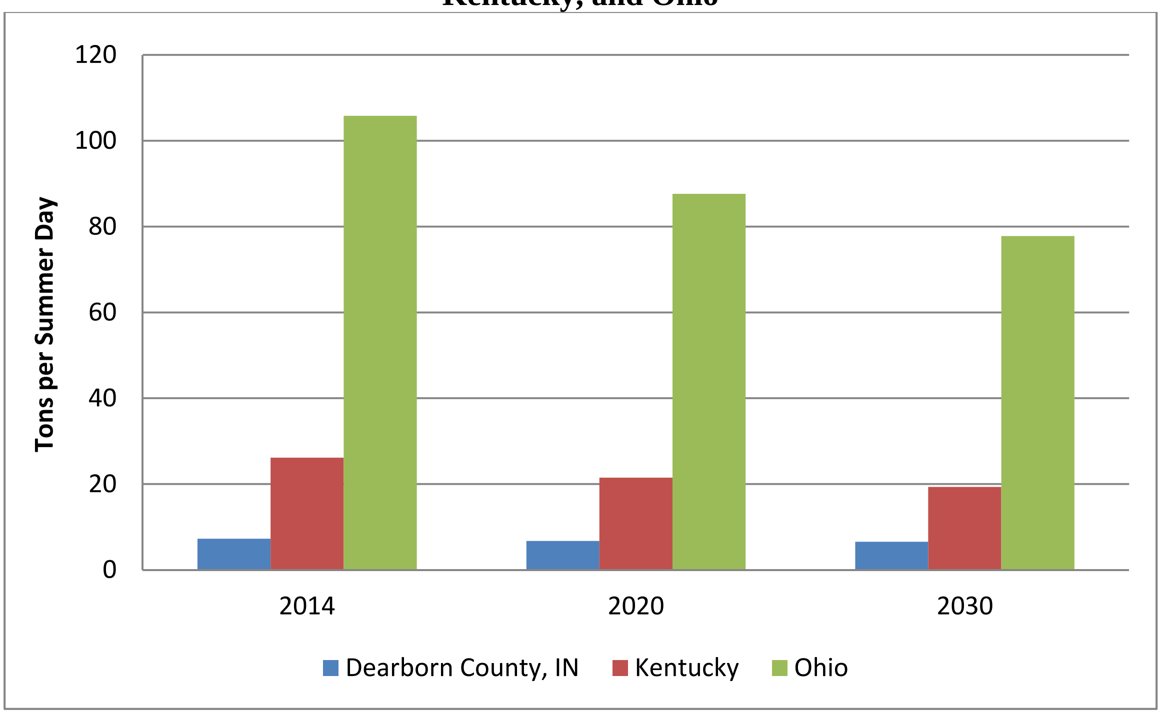
VOC Emissions by Category and Year, 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year), All Sources, Entire Nonattainment Area



Comparison of 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) NO_x Emissions, All Sources, Dearborn County, Indiana, Kentucky, and Ohio



Comparison of 2014 (Attainment-Year), 2020 (Interim-Year), and 2030 (Maintenance-Year) VOC Emissions, All Sources, Dearborn County, Indiana, Kentucky, and Ohio



2014 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)				
State	**County**	**Sector**	**NO_x**	**VOC**
Indiana	Dearborn	Area	0.47	1.75
Indiana	Dearborn	Nonroad	0.44	0.36
Indiana	Dearborn	Onroad	1.37	0.99
Indiana	Dearborn	EGU-Point	8.73	0.18
Indiana	Dearborn	Non-EGU-Point	2.71	4.01
Kentucky	Boone	Area	0.76	4.48
Kentucky	Boone	Nonroad	1.54	2.28
Kentucky	Boone	Onroad	6.14	2.82
Kentucky	Boone	EGU-Point	7.73	0.28
Kentucky	Boone	Non-EGU-Point	2.26	2.45
Kentucky	Campbell	Area	0.87	2.25
Kentucky	Campbell	Nonroad	0.57	0.60
Kentucky	Campbell	Onroad	3.83	1.76
Kentucky	Campbell	EGU-Point	0.00	0.00
Kentucky	Campbell	Non-EGU-Point	0.23	0.44
Kentucky	Kenton	Area	1.88	4.50
Kentucky	Kenton	Nonroad	1.18	1.01
Kentucky	Kenton	Onroad	5.81	2.67
Kentucky	Kenton	EGU-Point	0.00	0.00
Kentucky	Kenton	Non-EGU-Point	0.40	0.63
Ohio	Butler	Area	4.78	9.51
Ohio	Butler	Nonroad	3.39	2.61
Ohio	Butler	Onroad	8.85	7.59
Ohio	Butler	EGU-Point	0.73	0.02
Ohio	Butler	Non-EGU-Point	9.58	3.05
Ohio	Clermont	Area	1.14	5.36
Ohio	Clermont	Nonroad	1.81	1.73
Ohio	Clermont	Onroad	5.44	4.66
Ohio	Clermont	EGU-Point	38.17	0.28
Ohio	Clermont	Non-EGU-Point	0.14	0.22
Ohio	Clinton	Area	0.52	2.51
Ohio	Clinton	Nonroad	0.96	0.71
Ohio	Clinton	Onroad	3.51	1.53
Ohio	Clinton	EGU-Point	0.00	0.00
Ohio	Clinton	Non-EGU-Point	0.00	0.01
Ohio	Hamilton	Area	10.08	21.66
Ohio	Hamilton	Nonroad	6.76	6.54
Ohio	Hamilton	Onroad	24.37	20.88
Ohio	Hamilton	EGU-Point	14.47	0.23
Ohio	Hamilton	Non-EGU-Point	8.59	2.39
Ohio	Warren	Area	1.66	5.66
Ohio	Warren	Nonroad	2.55	1.93
Ohio	Warren	Onroad	7.12	6.10

Ohio	Warren	EGU-Point	0.00	0.00
Ohio	Warren	Non-EGU-Point	1.55	0.63

2020 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)				
State	**County**	**Sector**	**NO_x**	**VOC**
Indiana	Dearborn	Area	0.48	1.77
Indiana	Dearborn	Nonroad	0.30	0.29
Indiana	Dearborn	Onroad	0.74	0.62
Indiana	Dearborn	EGU-Point	0.26	0.05
Indiana	Dearborn	Non-EGU-Point	2.70	4.01
Kentucky	Boone	Area	0.76	4.22
Kentucky	Boone	Nonroad	1.05	1.80
Kentucky	Boone	Onroad	2.71	1.54
Kentucky	Boone	EGU-Point	8.07	0.28
Kentucky	Boone	Non-EGU-Point	2.47	2.43
Kentucky	Campbell	Area	0.87	2.17
Kentucky	Campbell	Nonroad	0.40	0.45
Kentucky	Campbell	Onroad	1.69	0.96
Kentucky	Campbell	EGU-Point	0.00	0.00
Kentucky	Campbell	Non-EGU-Point	0.23	0.43
Kentucky	Kenton	Area	1.88	4.28
Kentucky	Kenton	Nonroad	0.80	0.87
Kentucky	Kenton	Onroad	2.57	1.46
Kentucky	Kenton	EGU-Point	0.00	0.00
Kentucky	Kenton	Non-EGU-Point	0.40	0.61
Ohio	Butler	Area	4.78	9.38
Ohio	Butler	Nonroad	2.03	2.23
Ohio	Butler	Onroad	4.74	4.79
Ohio	Butler	EGU-Point	0.22	0.02
Ohio	Butler	Non-EGU-Point	9.57	2.99
Ohio	Clermont	Area	1.14	5.28
Ohio	Clermont	Nonroad	1.11	1.43
Ohio	Clermont	Onroad	2.91	2.94
Ohio	Clermont	EGU-Point	31.18	0.31
Ohio	Clermont	Non-EGU-Point	0.14	0.21
Ohio	Clinton	Area	0.52	2.54
Ohio	Clinton	Nonroad	0.64	0.51
Ohio	Clinton	Onroad	1.86	0.93
Ohio	Clinton	EGU-Point	0.00	0.00
Ohio	Clinton	Non-EGU-Point	0.00	0.01
Ohio	Hamilton	Area	10.08	21.30
Ohio	Hamilton	Nonroad	4.06	5.42
Ohio	Hamilton	Onroad	13.05	13.18
Ohio	Hamilton	EGU-Point	10.15	0.19
Ohio	Hamilton	Non-EGU-Point	8.60	2.39
Ohio	Warren	Area	1.66	5.59
Ohio	Warren	Nonroad	1.50	1.54
Ohio	Warren	Onroad	3.81	3.85

Ohio	Warren	EGU-Point	0.00	0.00
Ohio	Warren	Non-EGU-Point	1.54	0.61

2030 Cincinnati Area Emission Totals, All Sources (Tons per Summer Day)				
State	**County**	**Sector**	**NO_x**	**VOC**
Indiana	Dearborn	Area	0.48	1.85
Indiana	Dearborn	Nonroad	0.18	0.27
Indiana	Dearborn	Onroad	0.39	0.38
Indiana	Dearborn	EGU-Point	0.26	0.05
Indiana	Dearborn	Non-EGU-Point	2.70	4.01
Kentucky	Boone	Area	0.77	4.13
Kentucky	Boone	Nonroad	0.67	1.60
Kentucky	Boone	Onroad	1.18	0.86
Kentucky	Boone	EGU-Point	8.07	0.28
Kentucky	Boone	Non-EGU-Point	3.34	2.53
Kentucky	Campbell	Area	0.87	2.13
Kentucky	Campbell	Nonroad	0.26	0.40
Kentucky	Campbell	Onroad	0.74	0.54
Kentucky	Campbell	EGU-Point	0.00	0.00
Kentucky	Campbell	Non-EGU-Point	0.23	0.41
Kentucky	Kenton	Area	1.88	4.16
Kentucky	Kenton	Nonroad	0.50	0.92
Kentucky	Kenton	Onroad	1.12	0.82
Kentucky	Kenton	EGU-Point	0.00	0.00
Kentucky	Kenton	Non-EGU-Point	0.40	0.57
Ohio	Butler	Area	4.79	9.31
Ohio	Butler	Nonroad	1.16	2.43
Ohio	Butler	Onroad	2.44	2.88
Ohio	Butler	EGU-Point	0.26	0.02
Ohio	Butler	Non-EGU-Point	9.57	2.99
Ohio	Clermont	Area	1.15	5.20
Ohio	Clermont	Nonroad	0.63	1.46
Ohio	Clermont	Onroad	1.50	1.77
Ohio	Clermont	EGU-Point	31.18	0.43
Ohio	Clermont	Non-EGU-Point	0.14	0.21
Ohio	Clinton	Area	0.53	2.61
Ohio	Clinton	Nonroad	0.29	0.42
Ohio	Clinton	Onroad	1.28	0.71
Ohio	Clinton	EGU-Point	0.00	0.00
Ohio	Clinton	Non-EGU-Point	0.00	0.01
Ohio	Hamilton	Area	10.10	21.01
Ohio	Hamilton	Nonroad	2.59	5.87
Ohio	Hamilton	Onroad	6.71	7.92
Ohio	Hamilton	EGU-Point	10.15	0.24
Ohio	Hamilton	Non-EGU-Point	8.60	2.38
Ohio	Warren	Area	1.67	5.52
Ohio	Warren	Nonroad	0.78	1.51
Ohio	Warren	Onroad	1.96	2.32

Ohio	Warren	EGU-Point	0.00	0.00
Ohio	Warren	Non-EGU-Point	1.54	0.58

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APPENDIX F

Mobile Source Emissions Inventory Report

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Ozone Mobile Source Emissions Inventory for the Cincinnati Ozone Nonattainment Area

Includes the Ohio counties of Butler, Clermont, Clinton, Hamilton, and Warren, the Kentucky counties of Boone, Campbell and Kenton, and Dearborn County Indiana.
Emission estimates for the Years 2011, 2014, 2020 and 2030

August 2015

Prepared for the Ohio Environmental Protection Agency, the Kentucky Division for Air Quality and the Indiana Department of Environmental Management by

OKI Regional Council of Governments

Ohio · Kentucky · Indiana
Regional Council of Governments

Acknowledgments

Title	Ozone Mobile Source Emissions Inventory for the Cincinnati Ozone Nonattainment Area
Abstract	This report was prepared for the Ohio Environmental Protection Agency, the Kentucky Department for Air Quality, and the Indiana Department of Environmental Management. The Cincinnati Ozone Nonattainment Area includes a portion of Dearborn County Indiana, the counties of Boone, Campbell, Kenton in Kentucky, and the counties of Butler, Clermont, Clinton, Hamilton, and Warren in Ohio. Clinton County is outside of OKI's MPO area, however, the Ohio Department of Transportation prepared Clinton emission estimates which are included in this report. This report includes emission estimates for years 2011, 2014, 2020 and 2030. EPA's Motor Vehicle Emission Simulation (MOVES) 2014 was used to generate the emission inventory.
Date	August 2015
Agency	Ohio-Kentucky-Indiana Regional Council of Governments Mark Policinski, Executive Director Robert Koehler, P.E., Deputy Director
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Mobile Source Ozone Emissions Inventory for the Cincinnati Ozone Nonattainment Area

This report was prepared for the Ohio Environmental Protection Agency, the Kentucky Department for Air Quality, and the Indiana Department of Environmental Management. The Cincinnati 2008 Ozone Nonattainment Area includes a portion of Dearborn County Indiana, the counties of Boone, Campbell, Kenton in Kentucky, and the counties of Butler, Clermont, Clinton, Hamilton, and Warren in Ohio. Clinton County is outside of OKI's MPO planning area. The emission estimates for Clinton County were developed by the Ohio Department of Transportation and provided to OKI for inclusion in this report. This report includes emission estimates for years 2011, 2014, 2020 and 2030. The U.S. EPA's Motor Vehicle Emission Simulation (MOVES) 2014 was used to generate the emission inventory. Details on the various county data inputs used to generate the inventory are described in Table 5. Emissions of the ozone precursors, volatile organic compounds (VOC's) and oxides of nitrogen (NO_x), are reported.

Table 1 shows daily mobile source ozone emissions in tons per summer day for the Ohio and Indiana portion of the Cincinnati Ozone Nonattainment Area. The daily mobile source ozone emissions in tons per summer day for the Kentucky portion of the Cincinnati Ozone Nonattainment Area are shown in Table 2. The mobile source ozone emissions for the nonattainment portion only of each county is provided in Table 3. Mobile source emissions for entire counties are shown in Table 4.

Table 1

Mobile Source Emissions Inventory for the Indiana and Ohio Portions of the Cincinnati Ozone Nonattainment Area (tons per day)

	2011	**2014**	**2020**	**2030**
VOC	55.90	41.39	26.10	15.84
NOx	68.85	50.03	26.77	14.10

Table 2

Mobile Source Emissions Inventory for the Kentucky Portion of the Cincinnati Ozone Nonattainment Area (tons per day)

	2011	**2014**	**2020**	**2030**
VOC	8.47	6.50	3.54	1.99
NOx	17.72	14.04	6.20	2.69

Table 3				
Mobile Source Emissions by Nonattainment Portion (tons per summer day)				
State	**2011**	**2014**	**2020**	**2030**
Indiana				
Dearborn NonAttainment				
VOC	0.86	0.64	0.40	0.24
NOx	1.03	0.74	0.40	0.21
Ohio (entire county is NonAttainment)				
Butler				
VOC	10.21	7.59	4.79	2.88
NOx	12.24	8.85	4.74	2.44
Clermont				
VOC	6.27	4.66	2.94	1.77
NOx	7.52	5.44	2.91	1.50
Clinton				
VOC	2.27	1.53	0.93	0.71
NOx	4.53	3.51	1.86	1.28
Hamilton				
VOC	28.09	20.88	13.18	7.92
NOx	33.69	24.37	13.05	6.71
Warren				
VOC	8.21	6.10	3.85	2.32
NOx	9.84	7.12	3.81	1.96
OH/IN NonAttainment VOC Total	55.90	41.39	26.10	15.84
OH/IN NonAttainment NOx Total	68.85	50.03	26.77	14.10
Kentucky	**2011**	**2014**	**2020**	**2030**
Boone NA				
VOC	3.30	2.53	1.38	0.77
NOx	6.90	5.46	2.41	1.05
Campbell NA				
VOC	2.05	1.58	0.86	0.48
NOx	4.30	3.41	1.50	0.65
Kenton NA				
VOC	3.12	2.39	1.30	0.73
NOx	6.53	5.17	2.28	0.99
KY NonAttainment Total				
VOC	8.47	6.50	3.54	1.99
NOx	17.72	14.04	6.20	2.69

Table 4				
Mobile Source Emissions by County (tons per summer day)				
State	**2011**	**2014**	**2020**	**2030**
Indiana				
Dearborn				
VOC	1.33	0.99	0.62	0.38
NOx	1.89	1.37	0.74	0.39
Ohio				
Butler				
VOC	10.21	7.59	4.79	2.88
NOx	12.24	8.85	4.74	2.44
Clermont				
VOC	6.27	4.66	2.94	1.77
NOx	7.52	5.44	2.91	1.50
Clinton				
VOC	2.27	1.53	0.93	0.71
NOx	4.53	3.51	1.86	1.28
Hamilton				
VOC	28.09	20.88	13.18	7.92
NOx	33.69	24.37	13.05	6.71
Warren				
VOC	8.21	6.10	3.85	2.32
NOx	9.84	7.12	3.81	1.96
OH VOC Total	55.04	40.75	25.69	15.59
OH NOx Total	67.82	49.29	26.37	13.89
Kentucky	**2011**	**2014**	**2020**	**2030**
Boone				
VOC	3.68	2.82	1.54	0.86
NOx	7.75	6.14	2.71	1.18
Campbell				
VOC	2.29	1.76	0.96	0.54
NOx	4.83	3.83	1.69	0.74
Kenton				
VOC	3.48	2.67	1.46	0.82
NOx	7.34	5.81	2.57	1.12
KY Total				
VOC	9.46	7.26	3.95	2.22
NOx	19.93	15.78	6.97	3.03

Mobile Source Emission Forecast Process

Emission Factor Model

OKI's inventory assessment utilized U.S.EPA's emissions model MOVES 2014 to generate VOC and NO_X emissions. Table 5 summarizes the settings used in the MOVES run specification file. Table 6 lists the data used in the MOVES County-Data Manager. Further technical details on the use of MOVES are found in the appendix to the OKI report *"Mobile Source Emissions Inventory for Cincinnati PM2.5 Nonattainment Area"*, revised December 2010.

Table 5

MOVES RunSpec Parameter	Settings
MOVES 2014, default database 20141021	
Scale	County, Rates
Time Span	Time aggregation = Hour July weekday, July meteorological data All hours of day selected Weekdays only
Geographic Bounds	Two Custom Domains 1) 4 Ohio counties and Lawrenceburg IN; 2) 3 Kentucky counties
Vehicles/Equipment	All vehicle types. All vehicle/fuel type combos provided by MOVES except electric. Includes gasoline, diesel, ethanol and CNG.
Road Type	All road types including off-network
Pollutants and Processes	Total gaseous hydrocarbons, non-methane hydrocarbons, volatile organic compounds, and oxides of nitrogen
Strategies	none
General Output	Units= U.S. ton, joules and miles
Output Emissions	Time = 24-hour day, Location =county, on-road emission by road type
Advanced Performance	none

Table 6

County Data Manager	Data Source
Source Type Population	Local and default. Custom domain #1, local data from ODOT (2012) and InDOT (2011) motor vehicle registration data. Default data used for source types 41,51,52,53,54,61 and 62. Custom domain #2, local data from KYTC (2014) motor vehicle registration data. Default data used for source types 41,42,43,51,52,53,54,61 and 62. Annual growth rates used to adjust base year.
Vehicle Type VMT	Local and default. HPMSVTypeYear VMT= weekday DVMT from OKI

	travel demand model 8.0 with EPA's daily to annual VMT converter applied. monthVMTFraction = default. dayVMTFraction=default, hourVMTFraction=local.
I/M Programs	No I/M programs
Fuel Formulation	Default
Fuel Supply	Default
Meteorology Data	Default
Ramp Fraction	Local. OKI travel demand model.
Road Type Distribution	Local. OKI travel demand model.
Age Distribution	Local and default. Local data from ODOT (2012), InDOT (2011) and KYTC (2014) motor vehicle registration data. Default data used for source types 41,42,43,51,52,53,54,61 and 62.
Average Speed Distribution	Local. OKI travel demand model V8.0.

OKI Travel Demand Model

Vehicle miles traveled, vehicle hours and average speeds were estimated using the OKI Travel Demand Model Version 8.0. The OKI Travel Demand Model is composed of a series of CUBE Voyager programs written by Citilabs and OKI. The model covers the combined planning areas of OKI and the Miami Valley Regional Planning Commission. It is a state of the practice model that uses the standard 4 phase sequential modeling approach of trip generation, distribution, modal choice and assignment. The model uses demographic and land use data and capacity and free-flow speed characteristics for each roadway segment in the network to produce a "loaded" highway network with forecasted traffic volumes with revised speeds based on specified speed/capacity relationships.

Travel analysis zones are the basic geographic unit for estimating travel in the OKI model. The region is subdivided into 3312 traffic analysis zones to permit detail as well as manageability. A variety of socioeconomic data items are used in the OKI transportation planning process. These data are used primarily to forecast future travel patterns by serving as independent variables in OKI trip generation equations. The following categories of planning data are utilized:

- Population (household and group quarter)
- Households
- Household vehicles
- Employment (by employment category and zone of work)
- Labor force participation (by zone of residence)
- Area type

The principal data requirements of the OKI travel demand forecasting model are population and employment. From these variables, other characteristics including households, labor force, and personal vehicles may be derived. Chapter 3 of *OKI 2040 Regional Transportation Plan 2012 Update* provides a complete demographic overview of the region.

OKI utilizes both base year (2010) and future year data (2020, 2030 and 2040) in the planning process. Planning data are maintained at the Traffic Analysis Zone (TAZ) level, and originate in the 2010 Census of Population and Housing. Base year 2010 and future year data for each variable are developed through various methods. More detailed explanation of base year and future year data generation for each of the above-mentioned categories of planning data follows. All of the variables represent the latest OKI planning assumptions.

Population

Base and Future Year Data: Population data for base year 2010 and future years 2020, 2030 and 2040 originate with the 2010 US Census of Population. Utilizing the geographic information systems software ArcMap, population data at the zonal level for 2010 was derived from the area proportion allocation of census block level population.

As a tristate regional planning agency, OKI uses county level population projections prepared by the respective state data centers (Ohio Development Services, Kentucky State Data Center and Indiana Business Research Center) as control totals. The most current projections (years 2020 to 2040) were released by Ohio Development Services in 2013, Indiana Business Research Center in 2012 and the Kentucky State Data Center in 2012. Population projections at the zonal level are calculated by multiplying the 2010 household size by the projected zonal households. Then, household size is factored so that, in each county, the sum of the zonal populations equals the control total.

Households

Base Year Data: Household data for base year 2010 originates with the 2010 US Census of Population. Utilizing ArcMap, household data at the zonal level for 2010 was derived from the area proportion allocation of census block level households. Future Year Data: The development of household projections was accomplished by calculating the number of households for a projected county population using 2010 Census ratios of householders to total population by age specific cohorts for each future analysis year. This step results in county-level household control totals for each future analysis year. Disaggregation of households to TAZs was determined by historical trends, existing and future land use, topography, flood plain information, availability of land, local knowledge and other factors.

Household Vehicles

Base and Future Year Data: Base and future year household vehicle data were obtained from 2009-2013 American Community Survey tabulations at the block group level. Average vehicles per household were calculated for block groups and then applied to the TAZs associated with each block group. The 2020, 2030 and 2040 vehicles per household were held at the 2009-2013 level based on the fact that, since 2002, the number of vehicles per household has exceeded the number of drivers per household.

Labor Force

Base and Future Year Data: The OKI labor force is a function of the population as determined by a labor force participation rate (the number of employed persons in the labor force per persons 16 and over).

Household data for base year 2010 is derived from 2009-2013 American Community Survey tabulations. Utilizing ArcMap, labor force data at the zonal level for 2009-2013 was derived from the area proportion allocation of block group level. Labor force projections for 2020, 2030 and 2040 were based on the most recent projections of national labor force participation rates by age and sex cohorts from the U.S. Department of Labor, Bureau of Labor Statistics, for each of those years. These rates were then applied to the projected county age/sex cohorts and adjusted to eliminate the unemployed to arrive at a county employed labor force control total. Employed labor force at the zonal level is calculated by multiplying the labor force participation rate by the zonal population. The labor force participation rate is adjusted so that, in each county, the sum of the zonal labor force counts equals the control total.

Employment

Base Year Data: Quarterly Census of Employment and Wages (QCEW) data for 2010 was the primary tool used to calculate employment at the zonal level for the base year. Individual business records containing physical location, number of employees and NAICS code were geocoded in ArcMap and aggregated to the TAZ level. This data set was supplemented by other sources to complete the commuting employment picture in the OKI region. Each zone's employment was divided into 13 classes based on NAICS codes. NAICS codes assignment to a class was based on the potential for generating trips.

Future Year Data: For future year employment projection, calculation was first made of the employment at the regional level. At the regional level, employment is a calculation of the region's employed labor force minus workers who live in the region but commute out to work, plus workers who live outside the region but commute in to work. The regional total was disaggregated first to the county level based on historic trends and expected changes in the county's share of the region's employment and then to the TAZ level. Disaggregation to TAZs was determined by historical trends, existing and future land use, topography, flood plain information, availability of land, local knowledge and other factors.

Area Type

Base and Future Year Data: For each analysis year, each TAZ is assigned an area type designation as CBD, Urban, Suburban or Rural based on population and employment densities.

Model Calibration

OKI's Travel Demand Model has been validated to observed traffic volumes for the model base year 2005. The modeling network encompasses the entire ozone Maintenance area with the exception of Clinton County, Ohio. The modeling network also includes Greene, Miami and Montgomery counties in Ohio and the remainder of Dearborn County Indiana. The difference between estimated vehicle miles traveled (VMT) and 2005 observed VMT is less than 1%. A highway screenline analysis compares the screenline observed and simulated traffic volume discrepancies with the ODOT standard of maximum desirable deviation. The comparison shows that the model performs at a satisfactory level and all the errors were under the ODOT curve. Further information can be found in OKI's 2007 report, *"OKI/MVRPC*

Travel Demand Model Methodology/ Validation Report". For the calibration, OKI used over 3000 traffic counts collected through 2006 by the Ohio Department of Transportation (ODOT), the Kentucky Transportation Cabinet, many county and local governments, transportation engineering consultants, and OKI. These traffic counts cover nearly 50% percent of the links in the OKI portion of the modeling network. The methodology provides consistency with past emission inventory and conformity analysis work performed by OKI.

Local Inputs and Post-Model Processing

OKI incorporates a variety of sources of local data to both improve and confirm the accuracy of VMT, as well as other travel-related parameters. Free flow speeds used on the highway and transit networks are compared to third party data of actual travel speeds gathered by anonymous cell phones, in-vehicle navigation systems and GPS-enabled fleet vehicles. The OKI post-processing program, IMPACT, uses the loaded highway network to generate VMT by hour, VMT by speed distribution and VMT by facility type. These tables are then combined with MOVES emission factors to generate emissions. Two separate sets of VMT tables are generated: one for the four Ohio counties plus Dearborn County Indiana, and a second for the three Kentucky counties. The VMT by hour tables utilize hourly traffic distribution and directional split factors for different roadway types as developed by OKI. The main source of the data is traffic counts from the permanent traffic counting stations located throughout the OKI region for the years of 2008-2012. This data was supplemented with data collected at coverage count stations (locations with counts taken on only one-two days). The stations were classified by area type: urban and rural, and functional classification: freeway, arterial and collector. Speeds representing various "loaded" conditions (with traffic volumes) are estimated using techniques from the 2010 Highway Capacity Manual. This permits the estimation of speeds as conditions vary from hour to hour on the different facility types throughout the region. The IMPACT program performs the appropriate summation by area and roadway type as well as regional totals. OKI has also developed seasonal conversion factors to adjust traffic volumes to summer conditions. The factors were derived from local data collected at permanent traffic counting stations during 2008-2012 utilizing the average daily traffic monthly conversion factors for June, July and August.

APPENDIX G

Classification and Regression Tree Analysis

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Classification and Regression Tree Analysis

A classification and regression tree (CART) analysis was conducted by LADCO using 8-hour ozone monitoring data from three Cincinnati-area ozone sites: Colerain (ID number 39-061-00101), Sycamore (39-061-00061), and Taft (39-061-0040) measured from 2000-2014. The goal of the analysis was to determine the meteorological conditions associated with high ozone episodes in the Cincinnati air-shed and to construct trends for the days identified as sharing similar meteorological characteristics.

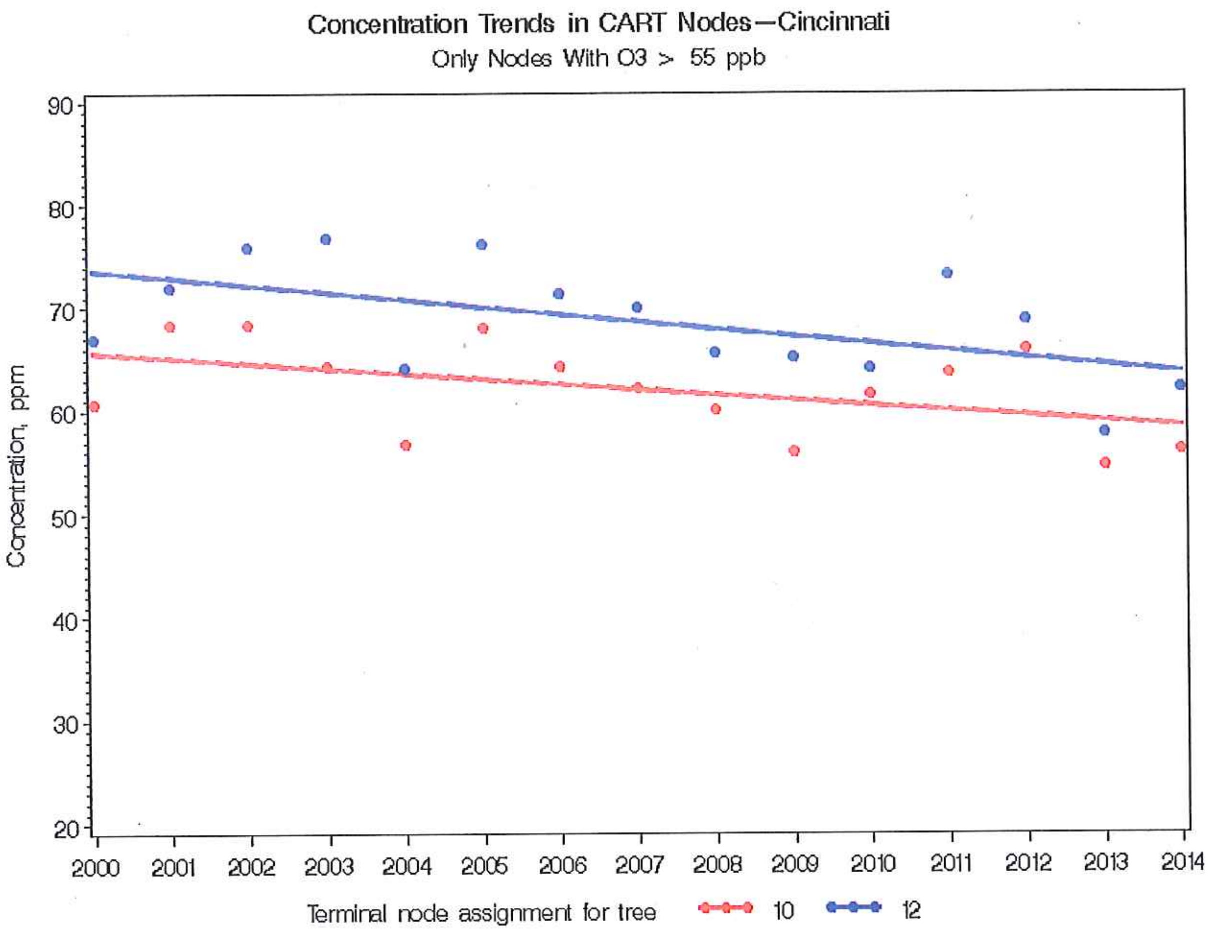
The CART analyses for the Cincinnati-area ozone study processed multiple meteorological variables for each day to determine which are the most effective at predicting ozone. Meteorological data collected for the Cincinnati CART analysis was taken from Cincinnati, Ohio - Municipal Airport's National Weather Service (NWS) station and processed by. Upper air observations, taken from the Dayton, Ohio - Wright Patterson Air Force Base Airport NWS site, were downloaded from the National Climatic Data's Center (NCDC) Integrated Global Radiosonde Archive. Meteorological variables included maximum and average daily temperatures, dew points, relative humidity and air pressure at the surface and different levels of the atmosphere, wind directions and wind speeds, change in temperatures and air pressure from the previous day, average wind speeds and temperatures over a 2 or 3-day period, day of the week, cloud cover, daily precipitation and many other parameters.

Regression trees, where each branch describes the meteorological conditions associated with different ozone concentrations, were developed to classify each summer day (May – September) by its ozone concentration and associated meteorological conditions. Although the exact selection of predictive variables changes from site to site, the universally common predictors are temperature, wind direction, and relative humidity. These are included in the dataset as daily averages and maximums as well as averages at specific times throughout the day (morning 7-10 am, afternoon 1-4 pm, etc.). Similar days were assigned to nodes, which are equivalent to branches of the regression tree. By grouping days with similar meteorology, the influence of meteorological variability on the underlying trend in ozone concentrations is partially removed; the remaining trend is presumed to be due to trends in precursor emissions or other non-meteorological influences. Ozone trends in these nodes were then plotted.

The CART analysis determined that two meteorological conditions had the strongest correlation with high ozone episodes: Node 10, representing south-southwest wind, and Node 12, representing a temperature difference between the surface and 925 mb greater than 2.26 K.

Chart 1, presented below, shows that, for both Node 10 and Node 12, monitored ozone values are trending lower for the most recent 15 years. This is to say, when wind directions are from the south-southwest and temperature changes at an altitude of 925 millibars are above 2.26^{o} Kelvin (parameters associated with the highest ozone values in the past), ozone values are trending lower.

Chart 1



By using a CART analysis to analyze the Cincinnati-area 8-hour ozone data, the influence of variations in meteorology can be mitigated such that comparisons of high ozone days with similar meteorological conditions can be made to determine if ozone values have decreased over time due to anthropogenic emission reductions. In general, ozone trends in the Cincinnati-area have declined. Furthermore, under meteorological conditions when monitored 8-hour ozone has historically been at its highest, ozone concentrations are lower under similar meteorological conditions. This analysis demonstrates that lower ozone values are not caused by favorable meteorological conditions and that progress in reducing ozone precursor emissions is the primary reason for lower 8-hour ozone concentrations in the Cincinnati metropolitan area.