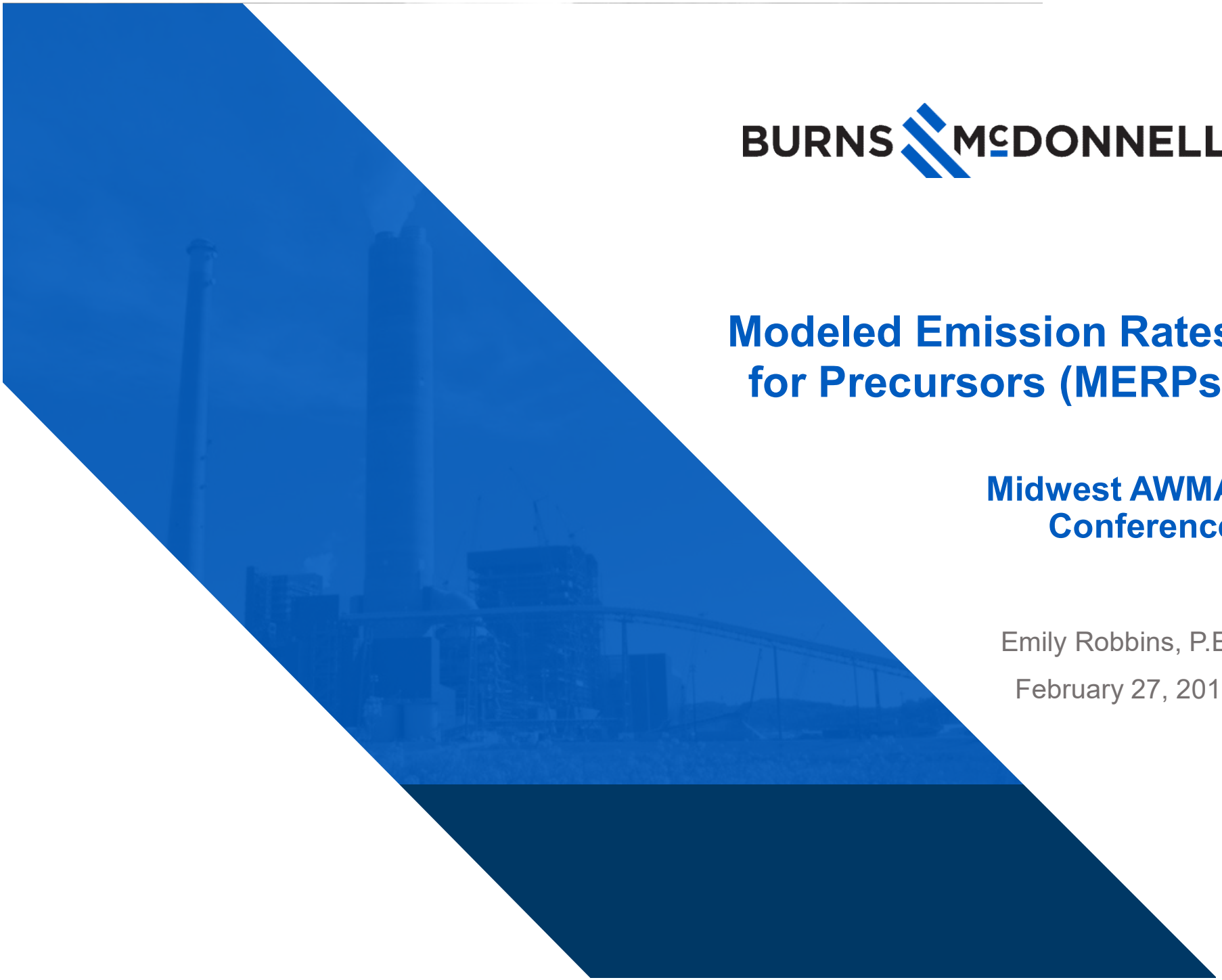


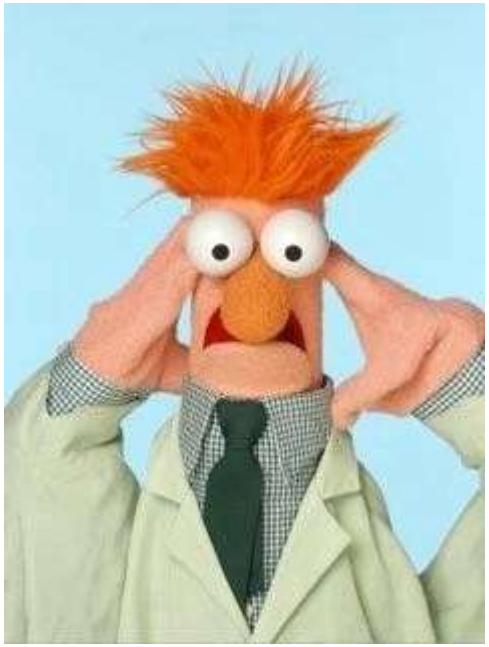
Modeled Emission Rates for Precursors (MERPs)

Midwest AWMA Conference

Emily Robbins, P.E.

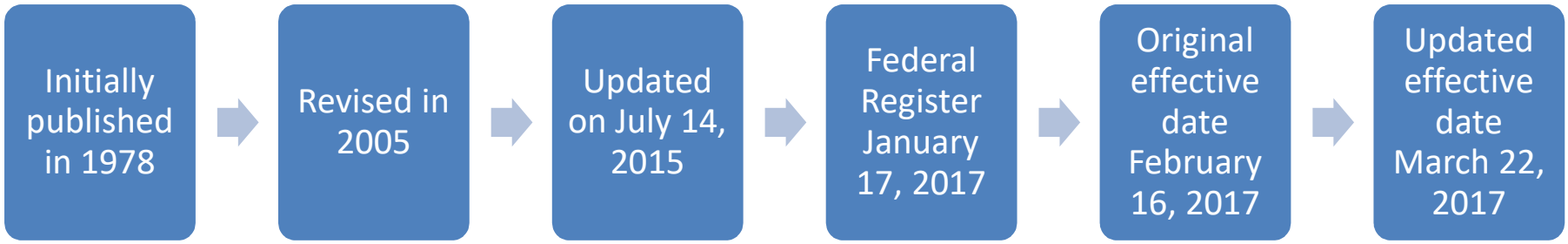
February 27, 2018

What are MERPs??

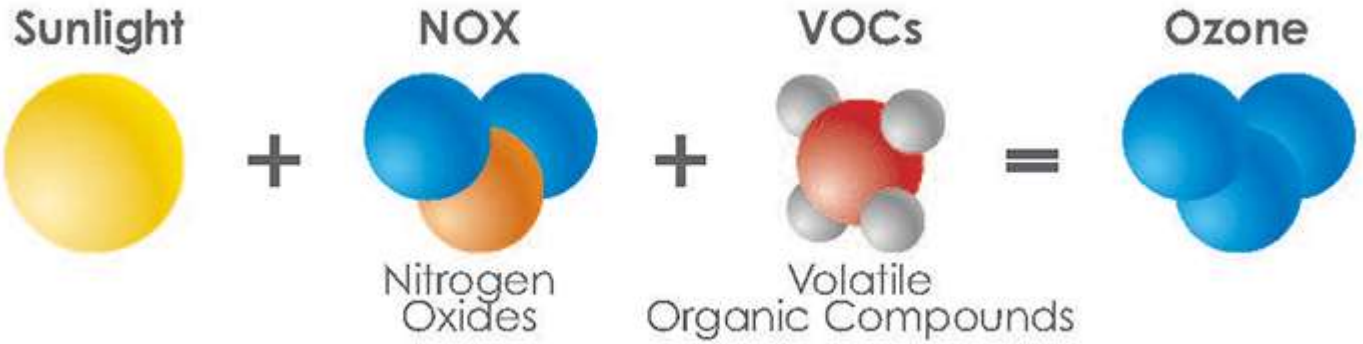


Appendix W – Guideline on Air Quality Models

- 40 Code of Federal Regulations (CFR) part 51 – Appendix W
- Per presidential directive, the effective date for Appendix W was delayed until March 22, 2017
- Finalized Appendix W addresses the secondary formation of $PM_{2.5}$ and ozone



Secondary Formation of Ozone



Secondary Formation of $PM_{2.5}$

Secondary $PM_{2.5}$ formation occurs due to chemical reaction of precursor gases in the atmosphere generally downwind some distance from the original emission source

Primarily formed from emissions of:

- NO_x
- SO_2

Secondary Formation of $PM_{2.5}$ and Ozone

- Section 5 of Appendix W addresses precursors
- Precursor analysis required for Prevention of Significant Deterioration (PSD) permit applications
- No preferred model or technique
- Two tier approach
  - Tier 1 - Technical analysis demonstrating the relationship between precursor emissions and the source's impacts. (Use existing information.)
  - Tier 2 - Case-specific chemical transport models
- Draft guidance for Tier 1 demonstration establishes thresholds for $PM_{2.5}$ and ozone
  - Modeled Emission Rates for Precursors (MERPs)

Tier 1 – Technical Analysis

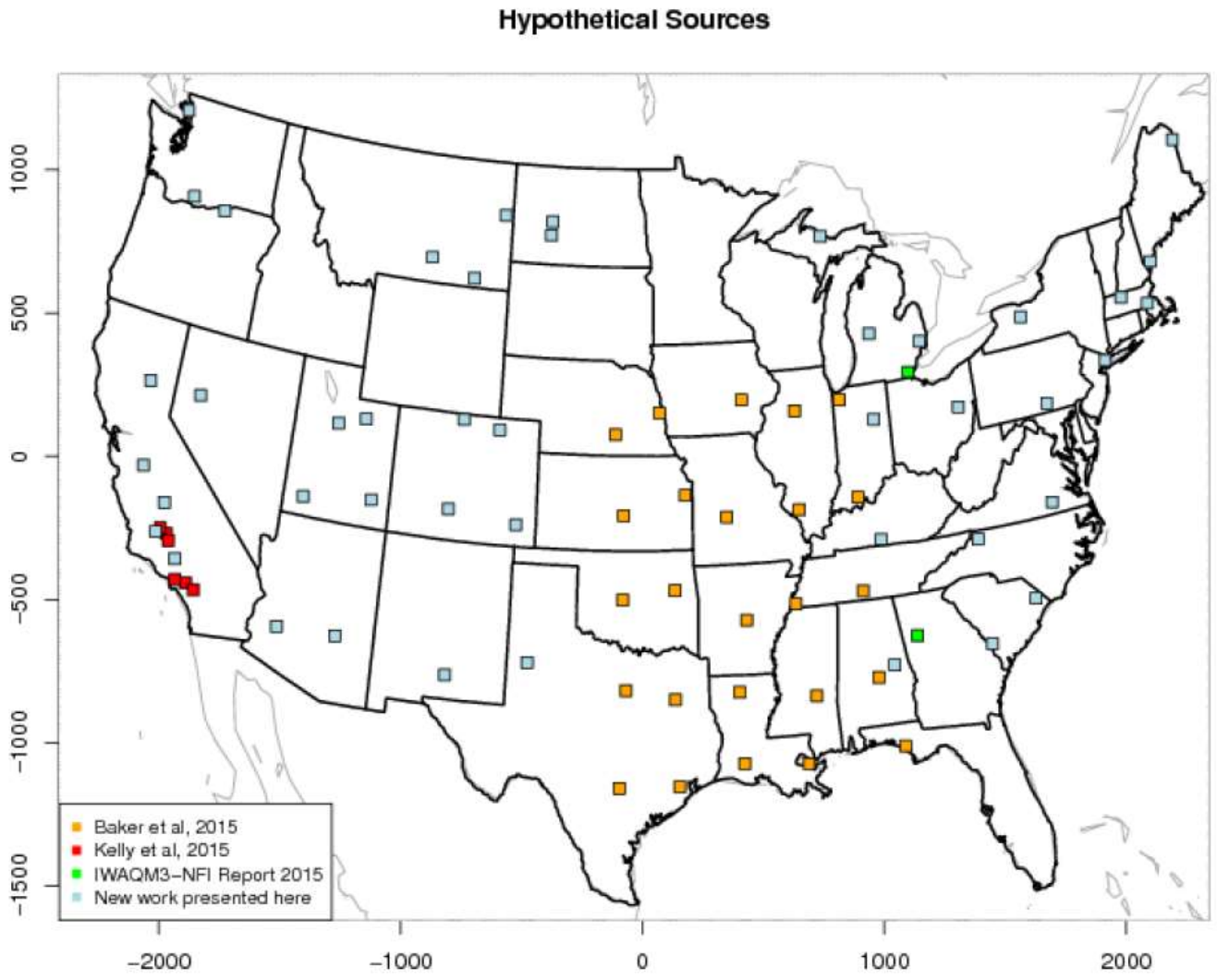
- A Modeled Emission Rate for Precursors (MERP) is a Tier 1 demonstration tool that represents the level of precursor emissions that is not expected to contribute to increased levels of ozone or $PM_{2.5}$
- MERPs provide a basis for evaluating a project's precursor emissions impact on secondary $PM_{2.5}$ and ozone formation because they reflect regional or local atmospheric conditions
- "Draft Guidance on the Development of MERPs as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program" describes the development of MERPs and procedure for performing a Tier 1 Analysis
  - Guidance slated to be finalized in early 2018

MERPs Development

- The EPA performed photochemical modeling to develop MERPs values

- Hypothetical sources were modeled at different precursor emission rates (500 TPY, 1,000 TPY, and 3,000 TPY), and as a surface release (denoted as L) or elevated release (denoted as H)

Figure 4-1. Hypothetical sources modeled for downwind secondary air quality impacts included in this assessment.



MERPs Development, cont.

- Modeled emission rates of hypothetical sources and the modeled air quality impacts of the hypothetical sources are located in Appendix A of the draft MERPs guidance document

Table A-1. Highest daily maximum 8-hour O_3 impacts from NO_X and VOC sources from multiple hypothetical source model simulations. Source locations are shown in Figures A1-A3.

Precursor	Area	Emissions (tpy)	Height	Source	FIPS	State	County	Max Impact (ppb)
NOx	CUS	500	H	1	18127	Indiana	Porter	1.15
NOx	CUS	500	H	2	18037	Indiana	Dubois	2.11
NOx	CUS	500	H	3	47055	Tennessee	Giles	3.21
NOx	CUS	500	H	4	1001	Alabama	Autauga	2.41
NOx	CUS	500	H	5	12005	Florida	Bay	1.04

MERPs Development, cont.

To calculate a MERP value, the EPA used the following method (described in section 5 of MERPs Guidance):

$$MERP = Critical\ Air\ Quality\ Threshold\ * \left(\frac{Modeled\ Emission\ Rate\ From\ Hypothetical\ Source}{Modeled\ Air\ Quality\ Impact\ from\ Hypothetical\ Source} \right)$$

The "critical air quality threshold" is the value used to determine if an impact causes or contributes to a violation of the NAAQS. Draft SIL values were used as the critical air quality thresholds for MERPs development.

Table 1. Recommended SIL Values for Ozone and $PM_{2.5}$ NAAQS

Criteria Pollutant (NAAQS level)	NAAQS SIL concentration
Ozone 8-hour (70 ppb)	1.0 ppb
$PM_{2.5}$ 24-hour (35 µg/m^3)	1.2 µg/m^3*
$PM_{2.5}$ annual (12 µg/m^3 or 15 µg/m^3)	0.2 µg/m^3

* The table takes into account the SIL value for the 24-hour $PM_{2.5}$ NAAQS that is in section 51.165(b)(2). Refer to the guidance discussion for details.

Source: Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, Revised August 18, 2016

MERPs Development, cont.

- The modeled emission rates, modeled air quality impacts, and critical air quality thresholds were used to calculate conservative MERP values for different regions of the country

Table 7.1 Most Conservative (Lowest) Illustrative MERP Values (tons per year) by Precursor, Pollutant and Region. Note: illustrative MERP values are derived based on the EPA modeling (as described in section 4) and critical air quality thresholds (as described in Section 5).

Precursor	Area	8-hr O3	Daily PM	Annual PM
NOx	Central US	126	1,820	7,427
NOx	Eastern US	107	2,467	10,037
NOx	Western US	184	1,155	3,184
SO2	Central US		256	1,795
SO2	Eastern US		675	4,013
SO2	Western US		225	2,289
VOC	Central US	948		
VOC	Eastern US	814		
VOC	Western US	1,049		

Example MERPs Analysis 1

A facility proposes to increase emissions by:

- 0 TPY primary $PM_{2.5}$
- 130 TPY of VOC
- 72 TPY of NO_x
- 0 TPY of SO_2

The facility is located in the Northeast region. Only VOC and NO_x emissions are above the PSD Significant Emission Rates (SERs), and therefore require a PSD compliance demonstration

Example MERPs Analysis 1, cont.

Secondary Ozone Analysis:

Table 7.1 Most Conservative (Lowest) Illustrative MERP Values (tons per year) by Precursor, Pollutant and Region. Note: illustrative MERP values are derived based on the EPA modeling (as described in section 4) and critical air quality thresholds (as described in Section 5).

Precursor	Area	8-hr O3	Daily PM	Annual PM
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SO2	Eastern US		675	4,013
SO2	Western US		225	2,289
VOC	Central US	948		
VOC	Eastern US	814		
VOC	Western US	1,049		

Example MERPs Analysis 1, cont.

Secondary Ozone Analysis:

- 72 TPY NOx from source < 107 TPY NOx 8-hr daily maximum ozone MERP
- 130 TPY from source < 814 TPY VOC 8-hr daily maximum ozone MERP

However, NOx and VOC precursor contributions to 8-hr maximum daily ozone are considered together. The proposed emissions can be expressed as a percent of the lowest MERP for each precursor and then summed:

(72 TPY NOx/107 TPY NOx 8-hr daily maximum ozone MERP) +
(130 TPY VOC/814 TPY VOC 8-hr daily maximum ozone MERP)

= 0.43 + 0.16 = 0.59 * 100 = 59%

Because this value is less than 100%, it indicates that the critical air quality threshold will not be exceeded when considering combined impacts.

Example MERPs Analysis 1, cont.

Secondary $PM_{2.5}$ Analysis:

Table 7.1 Most Conservative (Lowest) Illustrative MERP Values (tons per year) by Precursor, Pollutant and Region. Note: illustrative MERP values are derived based on the EPA modeling (as described in section 4) and critical air quality thresholds (as described in Section 5).

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VOC	Eastern US	814		
VOC	Western US	1,049		

Because the 72 TPY of NOx from the source is well below the lowest daily and annual $PM_{2.5}$ MERP values, air quality impacts of $PM_{2.5}$ are expected to be below the critical air quality threshold.

Example MERPs Analysis 2

A facility proposes to increase emissions by:

- 250 TPY primary $PM_{2.5}$
- 0 TPY of VOC
- 310 TPY of NO_x
- 75 TPY of SO_2

The facility is located in the Southeast region. NO_x, SO_2, and $PM_{2.5}$ emissions are above the PSD SERs, and therefore require a PSD compliance demonstration

Example MERPs Analysis 2, cont.

Secondary Ozone Analysis:

Table 7.1 Most Conservative (Lowest) Illustrative MERP Values (tons per year) by Precursor, Pollutant and Region. Note: illustrative MERP values are derived based on the EPA modeling (as described in section 4) and critical air quality thresholds (as described in Section 5).

Precursor	Area	8-hr O3	Daily PM	Annual PM
NOx	Central US	126	1,820	7,427
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SO2	Western US		225	2,289
VOC	Central US	948		
VOC	Eastern US	814		
VOC	Western US	1,049		

Example MERPs Analysis 2, cont.

Secondary Ozone Analysis:

- 310 TPY NOx from source > 107 TPY NOx 8-hr daily maximum ozone MERP

The NO_x emissions are greater than the lower (most conservative) NO_x MERP for 8-hr maximum daily ozone in the eastern region

- Identify a comparable source in Appendix A of the MERPs guidance document:

NOx	EUS	500	H	18	21009	Kentucky	Barren	2.95
NOx	EUS	500	H	19	1123	Alabama	Tallapoosa	1.53
NOx	EUS	500	L	1	23003	Maine	Aroostook	2.18

- EUS region, source 19 with elevated emissions release

Example MERPs Analysis 2, cont.

Secondary Ozone Analysis:

- Use the equation developed in Section 5 of the MERPs guidance document:

$$MERP = Critical\ Air\ Quality\ Threshold\ * \left(\frac{Modeled\ Emission\ Rate\ From\ Hypothetical\ Source}{Modeled\ Air\ Quality\ Impact\ from\ Hypothetical\ Source} \right)$$

MERP for Source 19 EUS Region Elevated Release (TPY) =

1.0 ppb * (500 TPY/1.53 ppb) = 329 TPY

- The source emissions of 310 TPY NO_x are less than the calculated NO_x MERP value for daily 8-hr ozone
  - Impacts of ozone from this source are expected to be below the critical air quality threshold

Example MERPs Analysis 2, cont.

Secondary $PM_{2.5}$ Analysis:

Table 7.1 Most Conservative (Lowest) Illustrative MERP Values (tons per year) by Precursor, Pollutant and Region. Note: illustrative MERP values are derived based on the EPA modeling (as described in section 4) and critical air quality thresholds (as described in Section 5).

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VOC	Eastern US	814		
VOC	Western US	1,049		

The source emissions are all below the individual MERP values, however the impacts of NO_x and SO_2 must be combined to determine the impacts on secondary $PM_{2.5}$ formation

Example MERPs Analysis 2, cont.

Daily $PM_{2.5}$ analysis :

(310 TPY NO_x/2,467 TPY NO_x daily $PM_{2.5}$ MERP) + (75 TPY SO_2/675 TPY SO_2 daily $PM_{2.5}$ MERP)

= 0.13 + 0.11 = 0.24 * 100 = 24%

- This value is less than 100%, but because there are primary $PM_{2.5}$ emissions, they must be combined with the secondary $PM_{2.5}$ to determine total impacts for the comparison to the air quality threshold

- Primary $PM_{2.5}$ impacts are modeled with AERMOD. For example, if modeled impacts for this source are 0.45 µg/m^3, primary $PM_{2.5}$ impacts would be 38% of the draft $PM_{2.5}$ SIL (1.2 µg/m^3)

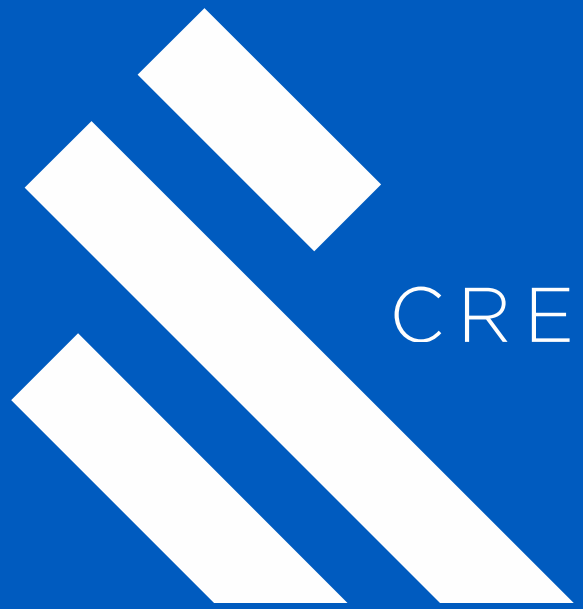
Total $PM_{2.5}$ impact = 24% + 38% = 62% of critical air quality threshold

- Perform the same analysis for annual $PM_{2.5}$ impacts

Things to Remember

- Guidance is still draft - methodologies and MERP values are still being finalized
  - States are requiring this analysis even though guidance is draft
- There is flexibility in determining MERP values
  - Can work with state/local agency or EPA region to develop the appropriate methodology for a Tier 1 demonstration
- Other methodologies not discussed in this presentation
  - Using representative sources not in your region
  - Performing your own modeling to develop MERP values for your project

Questions?



CREATE AMAZING.