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1-hour NO₂ Air Dispersion Modeling Updates and Case Studies

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Outline

- > Brief Background on 1-hour NO₂ Standard
- > Webinar/Memorandum from EPA
- > Non-NO₂ Specific Options
 - ❖ ADJ_U*
 - ❖ LOWWIND1
 - ❖ LOWWIND2
- > NO₂ Specific Options
 - ❖ ARM/ARM2
 - ❖ PVMRM
 - ❖ OLM

“New” NO₂ NAAQS for 1-hour

- > 1-hour NO₂ Standard (188 µg/m³)
 - ❖ Published in FR on February 9, 2010
 - ❖ Added a 1-hour form of the standard to the existing annual standard effective on April 12, 2010
 - ❖ NO₂ standard is 3-year average of 98th percentile of annual distribution of daily maximum 1-hour concentrations
 - ❖ Interim 1-hour NO₂ Significant Impact Level (SIL) issued in EPA Guidance June 2010 - 4 ppb (7.5 µg/m³)

NO₂ Webinar/Clarification Memo

- > Webinar on August 12, 2014
- > Memo released on September 30, 2014
 - ❖ “Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO₂ National Ambient Air Quality Standard”

Non-NO₂ Specific Options - Low Wind Speed Options

Low Wind Beta Options

> Three Options

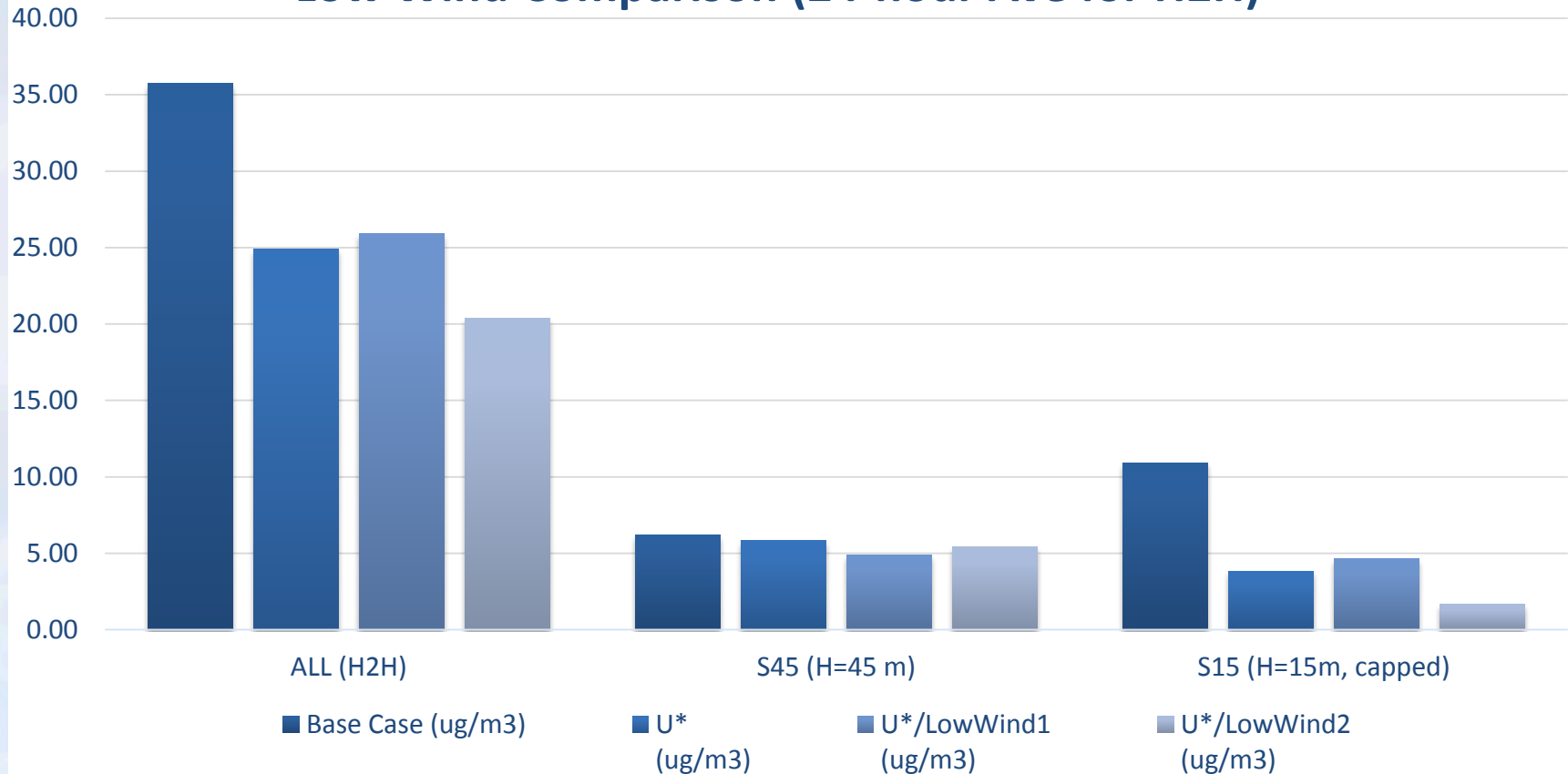
- ❖ ADJ_U* in AERMET
- ❖ LOWWIND1 in AERMOD
- ❖ LOWWIND2 in AERMOD

> Low wind speed options purpose

- ❖ Increase turbulence during low wind speed, stable conditions
- ❖ AERMOD has been shown to over-predict in these cases
- ❖ Should lower concentrations for low level releases
- ❖ Could increase concentration for elevated releases

Low Wind Beta Option Case Study

Low Wind Comparison (24-hour Ave for H2H)[†]



[†] Base case H2H max impact occurs on May 19, 2009 at Receptor alpha. All results provided above are for this time and location.

NO₂ Specific Options - Use of NO₂ Tiered Methods

NO_x vs. NO_2

- > 1-hour and annual NAAQS are for NO_2
- > Regulated pollutant for PSD is NO_x
 - ❖ NO_x emissions consist of NO and NO_2
- > Chemical reactions occur in the atmosphere through which some NO is converted to NO_2
 - ❖ NO interacts with ambient ozone to form NO_2 and oxygen

NO_x vs. NO₂

- > *Guideline on Air Quality Models (GAQM)* (November 2005) allows three tiered method to estimate NO to NO₂ conversion
 - ❖ Section 5.2.4
- > Modeled compliance with annual standard was generally “easy”
 - ❖ Assumption that 100% of NO_x is NO₂ was most commonly made
- > 1-hour NO₂ NAAQS has resulted in closer look at three tiered methods

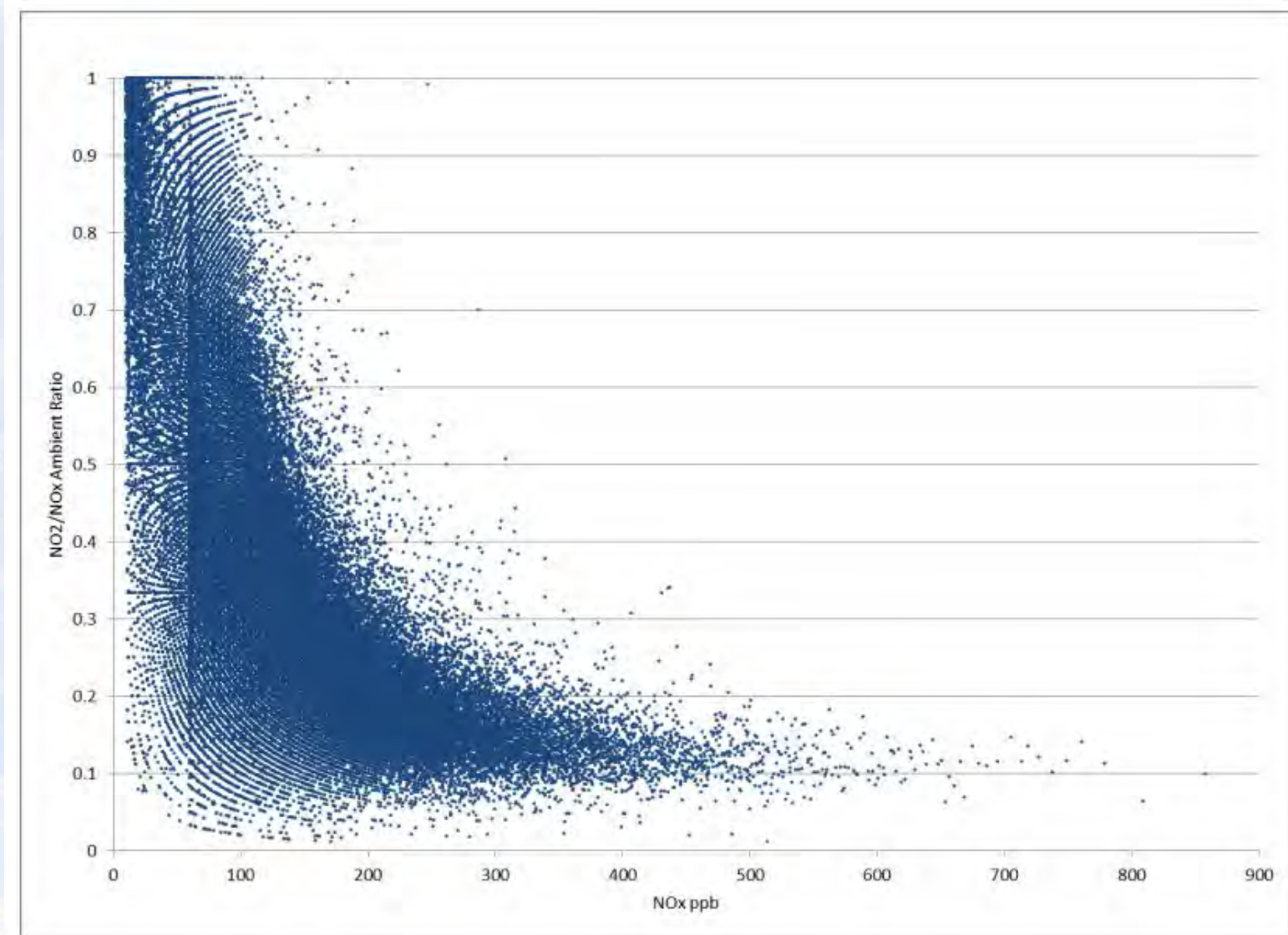
Three Tiers

- > Tier 1: Full NO to NO₂ conversion
- > Tier 2: Ambient ratio applied to Tier 1 result
 - ❖ Sometimes called **Ambient Ratio Method (ARM)**
 - ❖ Annual default ratio is 0.75 per *GAQM*
 - ❖ 1-hour default ratio is 0.80 per March 1, 2011 Clarification Memo
 - ❖ No justification/approval needed
- > Tier 2b: beta ARM2
 - ❖ Refined version Ambient Ratio Method
 - ❖ Ratio varies from 0.2 - 0.9 based on NO_x concentration
- > Tier 3: “Detailed Screening Methods”
 - ❖ PVMRM (plume volume molar ratio method)
 - ❖ OLM (ozone limiting method)

Beta ARM2 Option

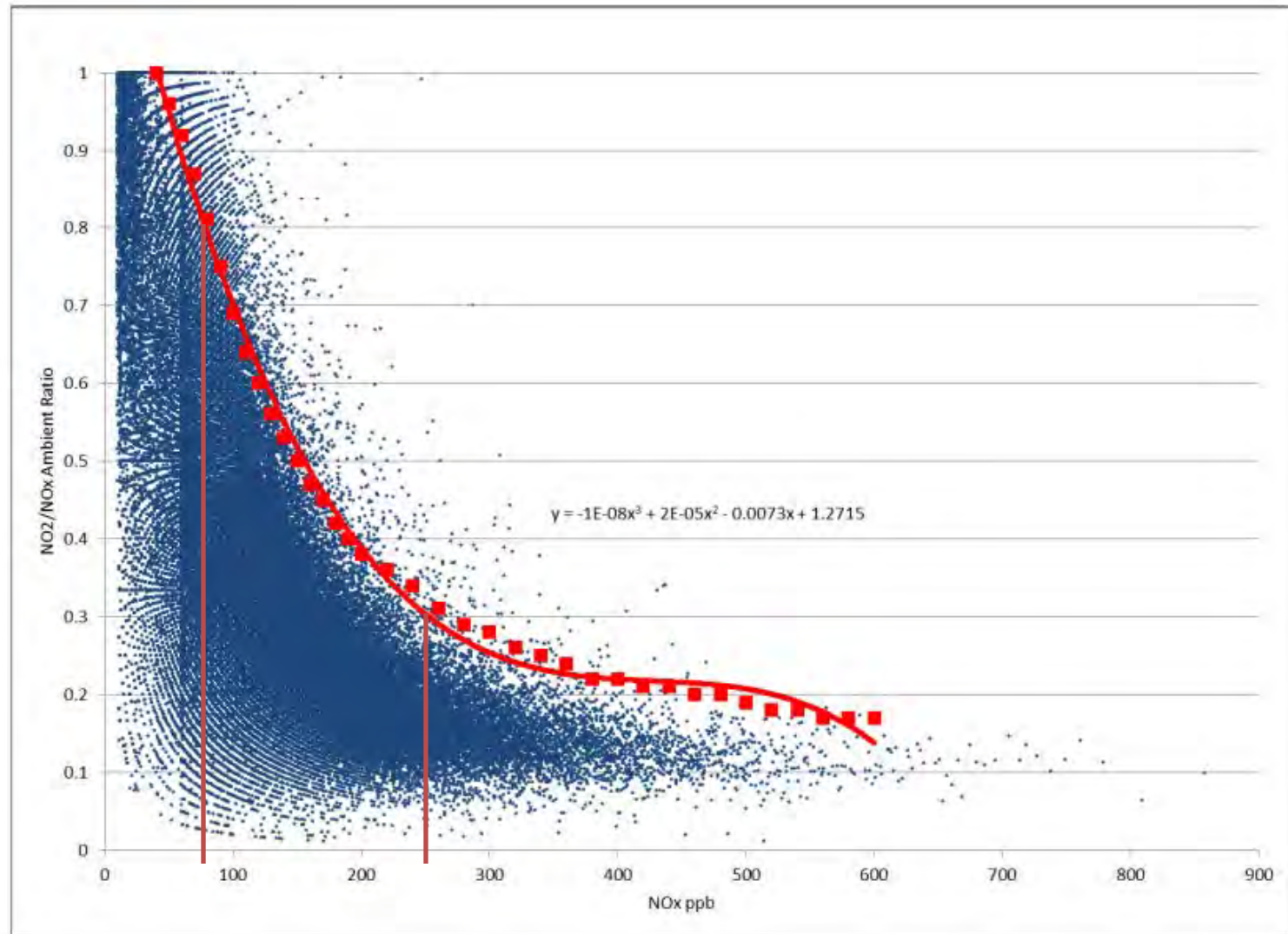
- > Development and Evaluation Report
 - ❖ Prepared for API by RTP Environmental, September 20, 2013
- > Incorporated into AERMOD 13350 as Beta option
 - ❖ Specify upper and lower limits on ambient ratio
 - ◆ Defaults are 0.9 and 0.2
 - ❖ Numerous bug fixes related to ARM2 in AERMOD 14134

ARM2



From: 2013 RSL Meeting Presentation by Mark Podrez of RTP Env. Assoc.

ARM2 Beta Option



From: 2013 RSL Meeting Presentation by Mark Podrez of RTP Env. Assoc.

ARM2 Beta Option

- > Non-Regulatory Default
 - ❖ Use is considered an “alternative model”
 - ❖ Needs EPA Regional Office Approval
 - ❖ Use App W Section 3.2 for justification
- > EPA has indicated (verbally) that ARM2 is more like ADJ_U* than LOWWIND in terms of ease of approval
 - ❖ No cases where ARM2 has been approved at EPA level for PSD projects yet

Tier 3 Considerations

- > Case by case assessment until clearer guidance from EPA
 - ❖ Need approval from EPA Regional Office to use
- > Three variables to input
 - ❖ In-stack NO_2/NO_x ratio (ISR) for each stack
 - ❖ Equilibrium ratio (ER) downwind
 - ❖ Background ozone

Tier 3 Considerations

- > Default in-stack ratio: 0.5
 - ❖ March 1, 2011 Clarification Memo
 - ❖ Likely very high for most boilers
 - ❖ Use unit specific information if possible
- > Default equilibrium ratio: 0.9
- > Background ozone
 - ❖ Constant value?
 - ❖ Time varying?
 - ◆ Not all ozone monitors operate for entire year

Tier 3 Considerations

- > Get most benefit with:
 - ❖ High NO_x emission rates
 - ❖ Low in-stack ratios
 - ❖ Low ambient ozone concentrations
- > EPA states neither PVMRM nor OLM is inherently superior
 - ❖ PVMRM represents more refined treatment for isolated, elevated point sources
 - ❖ Algorithm for determining which plumes “complete” for ozone is not thoroughly validated

ARM2 and PVMRM/OLM Improvement

- > Possible to see NO₂ concentrations at 10% of modeled NO_x in best cases for PVMRM/OLM, 20% for ARM2
 - ❖ High emission rates/concentrations lead to better ratios in both cases
 - ❖ High impacts near fenceline for PVMRM / OLM leads to better ratios
- > If forced to use default 0.5 in-stack ratio, ARM2 could be better than PVMRM
- > For low concentrations and/or far impacts, default ARM (80%) could be better than ARM2 or PVMRM/OLM
 - ❖ Both have 90% upper-bound ambient ratios

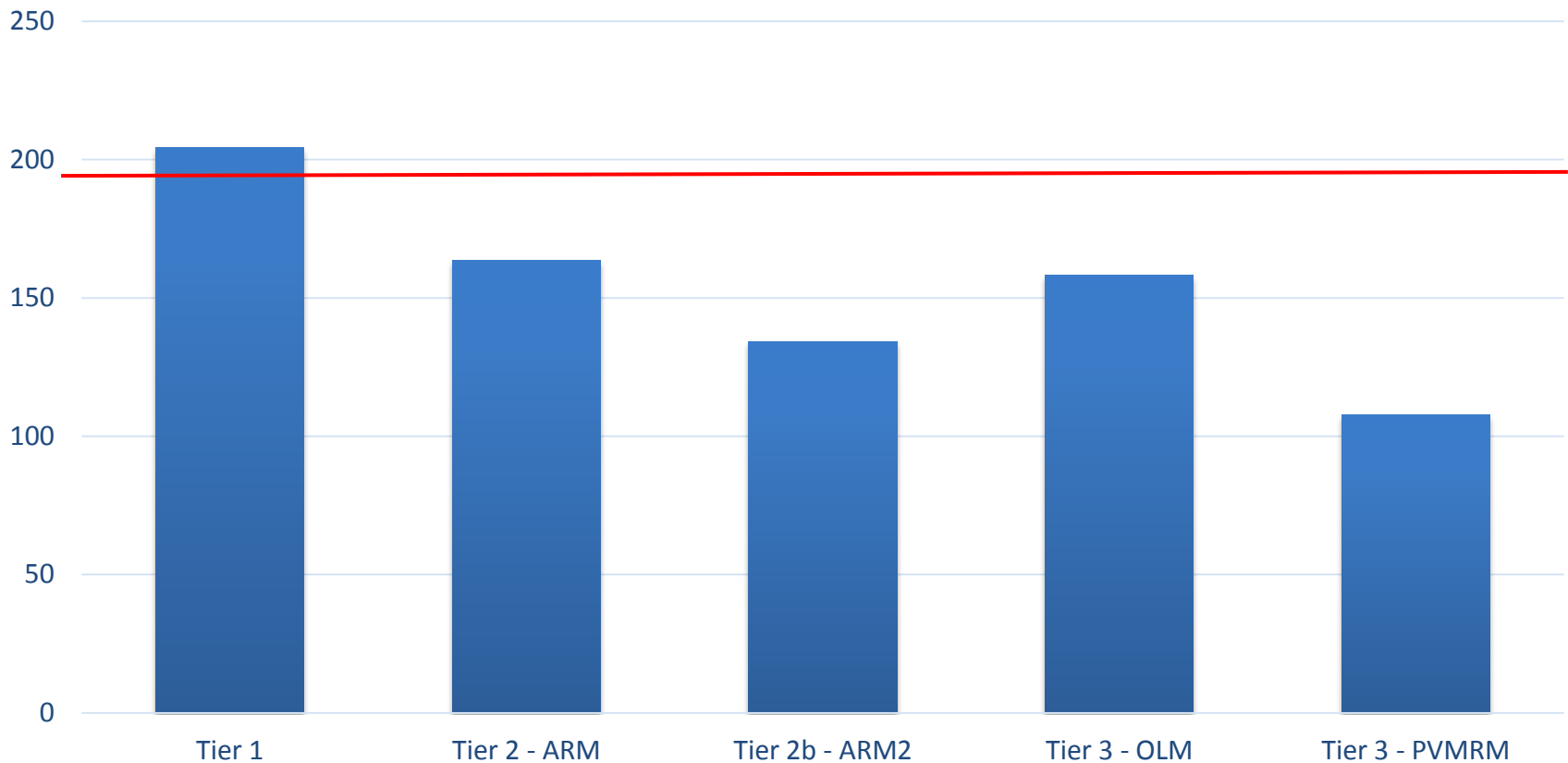
NO₂ Case Study 1

> Case 1:

- ❖ Single Tall Stack (180 feet)
- ❖ Default ISR/ER used
- ❖ Temporarily Varying Ozone Data
- ❖ Flat Terrain
- ❖ Some Structures

NO₂ Case Study 1

NO₂ Tier Method Comparison



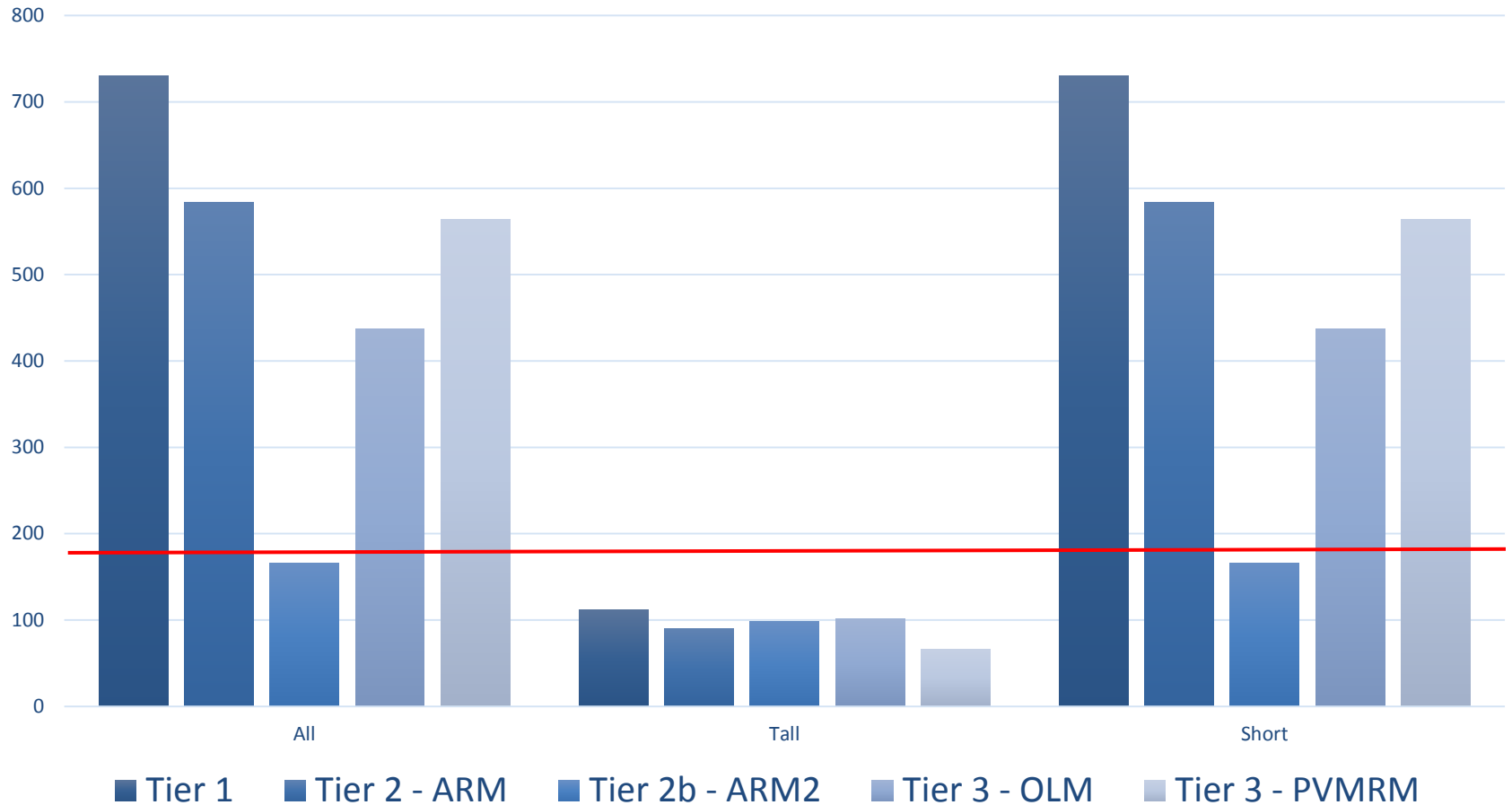
NO₂ Case Study 2

> Case 2:

- ❖ One Tall Stack (180 feet) and One Short Stack (10 feet)
- ❖ Default ISR/ER used
- ❖ Temporarily Varying Ozone Data
- ❖ Flat Terrain
- ❖ Some Structures

NO₂ Case Study 2

NO₂ Tier Method Comparison



Summary & Conclusions

- > New low wind beta options extremely promising for low level sources
- > Remember that beta also means new and untested - so be cautious about potential errors
- > Approval for using beta or other non-regulatory-default options can seem daunting
 - ❖ **BUT**, if permit timeline allows, could be much less costly than alternatives (e.g., control device installation, stack height increases, emission limitations, property purchase, etc.)
 - ❖ Many cases of approval of non-regulatory options (e.g., PVMRM/OLM), but no requests yet for the new beta low wind options

Questions



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