# Southern New Mexico Ozone Modeling Study

University of North Carolina (UNC-IE)
Ramboll-Environ (RE)

November 12, 2015

WESTAR

Western Regional Air Partnership

RAMBOLL ENVIRON

UNC INSTITUTE FOR THE ENVIRONMENT

# Summary

- Task 1: Meteorology (WRF) Modeling Update
- Task 2: Permian Basin Oil and Gas Emissions Data Approach
- Task 3: Mexico Inventories
- Decide on Projection Year for Modeling
- Next Steps
- Action Items and Next Call

# Task 1: Meteorology Modeling Update

## WRF Configurations

| WRF Treatment | 3SAQS/WAQS | SNMOS |
|---|---|---|
| Microphysics | Thompson | Thompson |
| Longwave Radiation | RRTMG | RRTMG |
| Shortwave Radiation | RRTMG | RRTMG |
| Minutes between radiation physics calls | 20 | 20 |
| Land Surface Model (LSM) | NOAH | NOAH |
| Planetary Boundary Layer (PBL) scheme | YSU | YSU |
| Cumulus parameterization | Kain-Fritsch in the 36-km and 12-km domains only. | Kain-Fritsch in the 36-km and 12-km domains only. |
| Analysis nudging | Applied to winds (uv), temperature (t) and moisture (q) in the 36-km and 12-km domains | Applied to winds (uv), temperature (t) and moisture (q) in the 36-km and 12-km domains |
| Analysis nudging coefficients | uv: 5e-4 (d01), 3e-4 (d02)<br>t: 5e-4 (d01), 3e-4 (d02)<br>q: 1e-5 (d01 and d02) | uv: 5e-4 (d01), 3e-4 (d02)<br>t: 5e-4 (d01), 3e-4 (d02)<br>q: 1e-5 (d01 and d02) |
| Observation Nudging | Applied to surface wind and temperature in the 4-km domain | None |
| Observation nudging coefficients | uv: 1.2e-3 (d03)<br>t: 6e-4 (d03) | N/A |
| Initialization Dataset | 12-km North American Model (NAM) | Decided after analysis of sensitivity modeling experiments |
| Top (mb) | 50 | 50 |
| Vertical Levels (Layers) | 37 (36) | 33 (32) |

# Task 1: Meteorology Modeling Update

## WRF Configurations

1. NAM KF Mods
   - North American Mesoscale Model (NAM) ICBCs
   - Modified Kain-Fritsch cumulus scheme
2. NAM MSKF
   - Configuration 1 + multi-scale (grid-aware) Kain-Fritsch
3. ERA MSKF
   - Configuration 2, swapping NAM ICBCs with European Center for Medium Range Forecasting (ECMWF) reanalysis (ERA-Interim) ICBCs
4. ERA MSKF AN
   - Configuration 3 with no analysis nudging in the 12-km domain (36-km domain only)

# Task 1: Meteorology Modeling Update

## WRF Configuration Results

http://ie.unc.edu/cempd/projects/data_viewer/results.cfm?project=SNMOS

- View the results from a single simulation
- MET → WRF → AMET for statistical plots of temperature, winds, humidity performance
- MET → WRF → PRISM for qualitative plots of daily total precipitation

# Task 2: Permian Basin Oil and Gas Emissions

## Base and Future Year Inventories

- See draft memo from Ramboll-Environ

# Task 3: Emissions Modeling Update

## Base and Future Year Mexico Inventories

- US EPA 2011 Modeling Platforms
  - **NEI 2011v1**
    - 1999 Mexico NEI (INEM) projection to 2012
    - Documentation: EPA TSD; ERG Inventory Conference Paper
    - Projection years: 2018, 2025
  - **NEI 2011v2**
    - 2008 INEM inventory with corrections
    - Documentation: ERG report to EPA
    - Projection Years: 2018, 2025

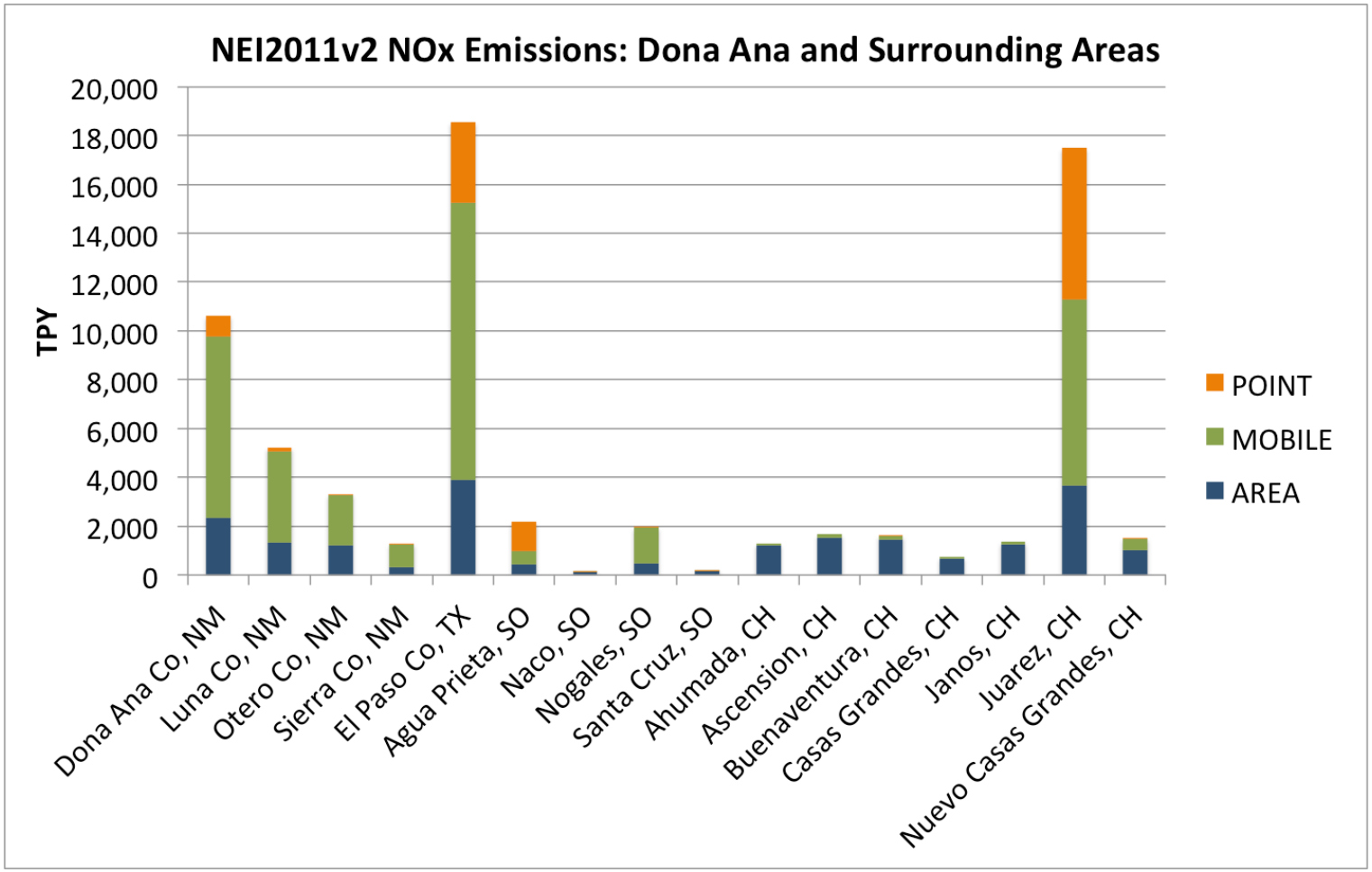
# Task 3: Emissions Modeling Update

## Base and Future Year Mexico Inventories

- September 30 SNMOS call decision made to use NEI2011v2 Mexico inventories
- Mexico 2008, 2018, and 2025 inventories
  - Based on work by SEMARNAT published in early 2014 (Inventario Nacional de Emisiones de México)
  - Eastern Research Group (ERG) reviewed and improved the inventory for EPA in late 2014
  - Documentation: ERG Report

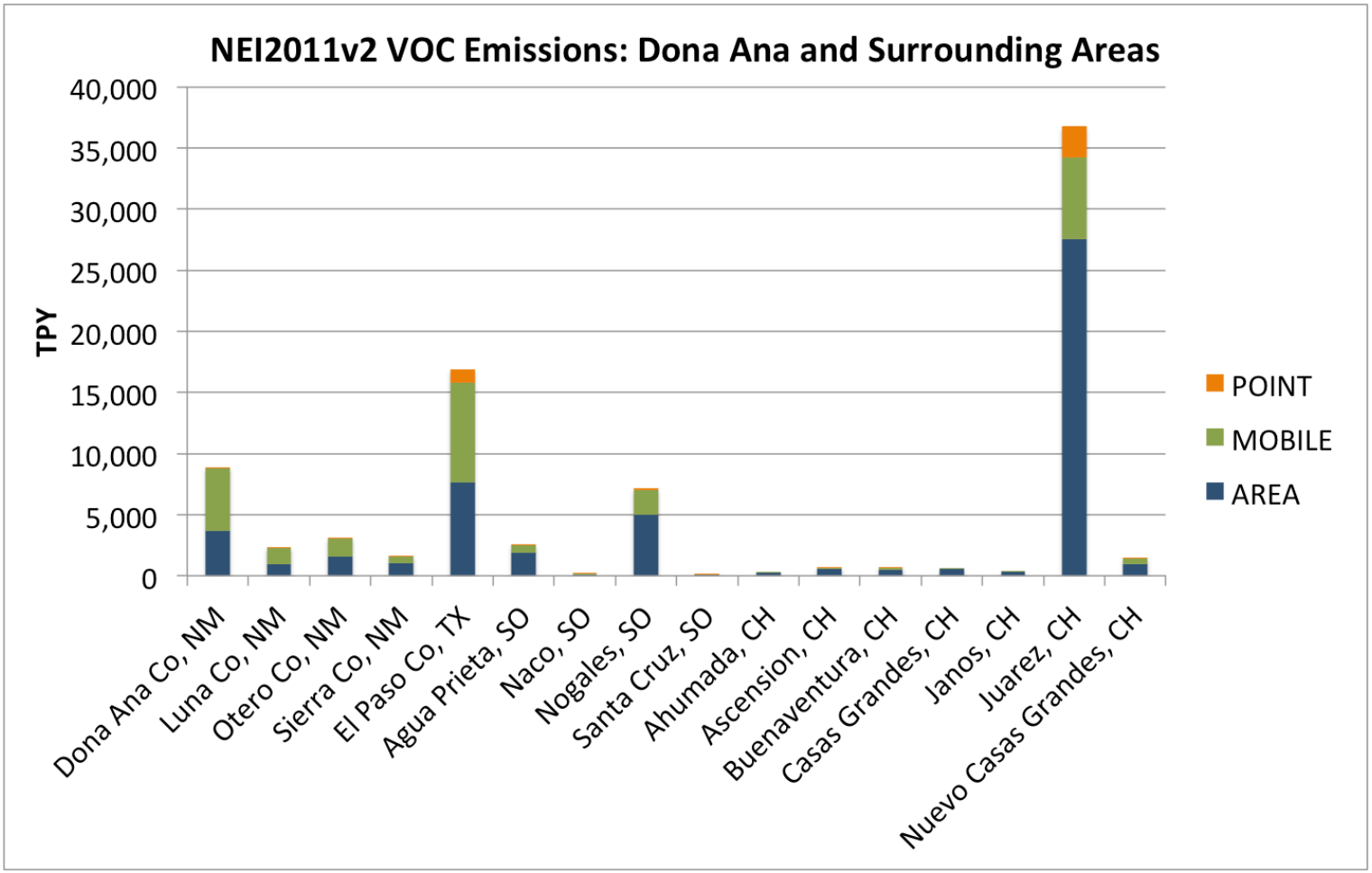
# Emissions Modeling Update

## Doña Ana and Surrounding Counties 2011 NOx EI



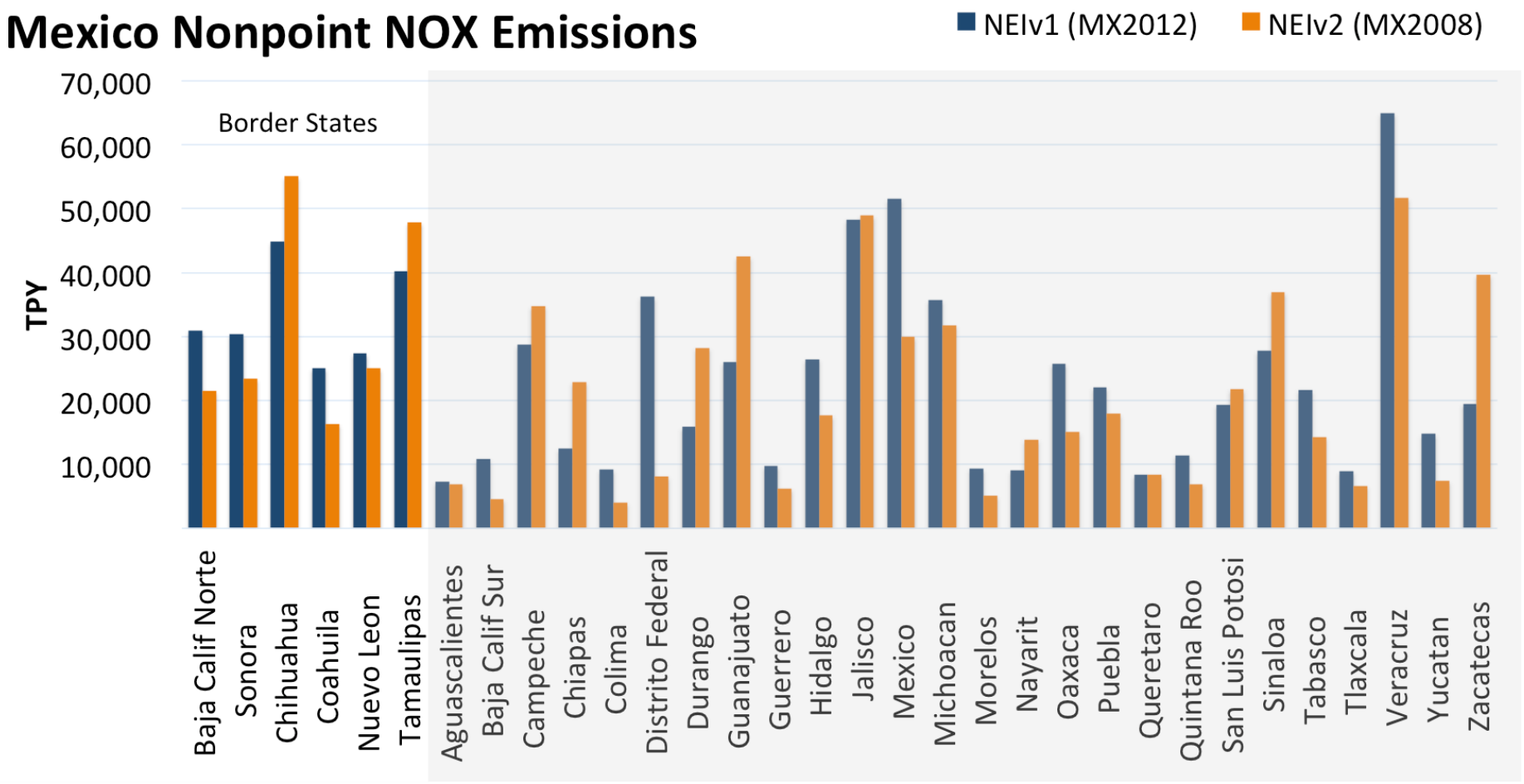
# Emissions Modeling Update

## Doña Ana and Surrounding Counties 2011 VOC EI



# Emissions Modeling Update

## Mexico Inventory Analysis



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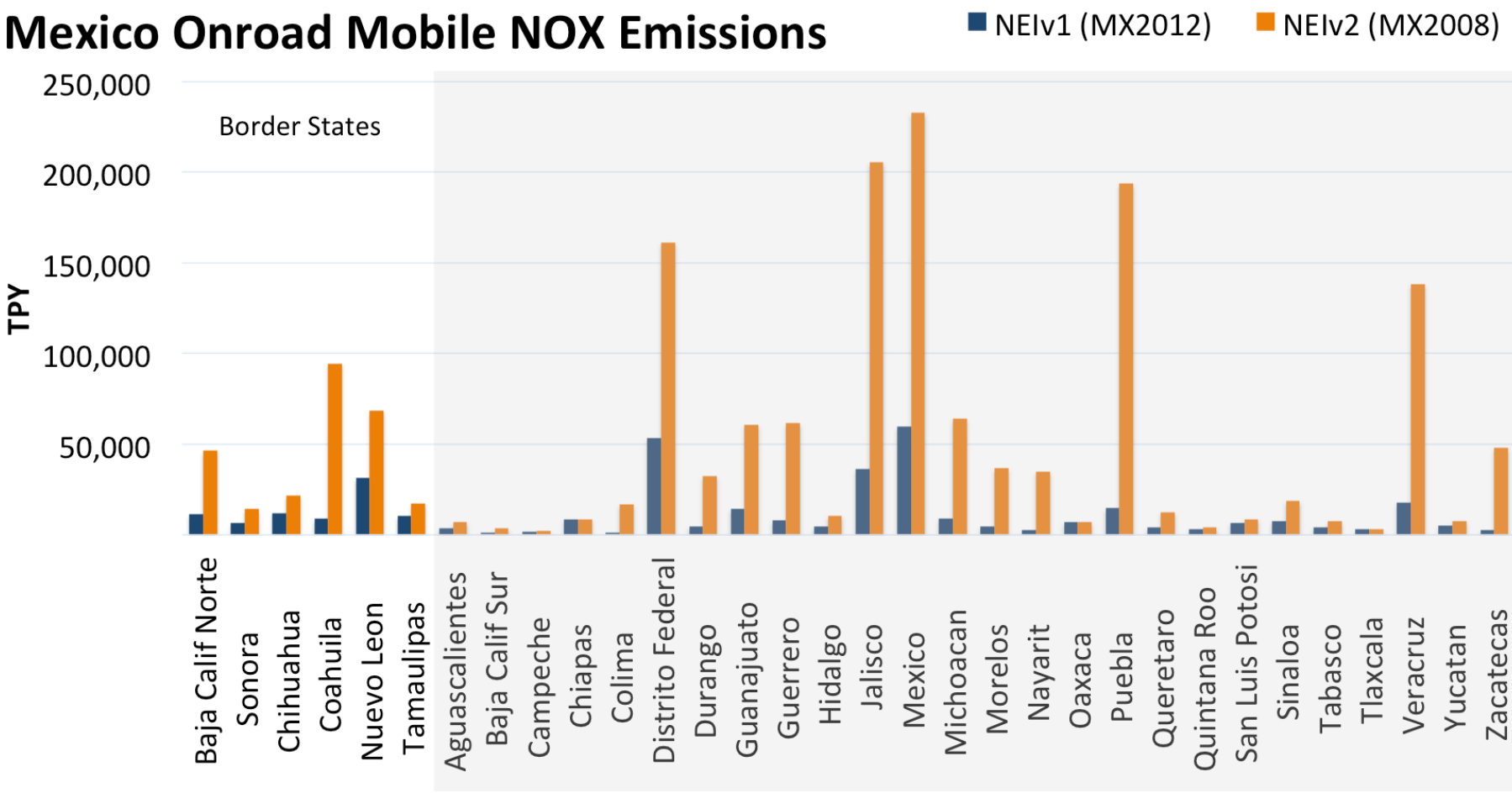

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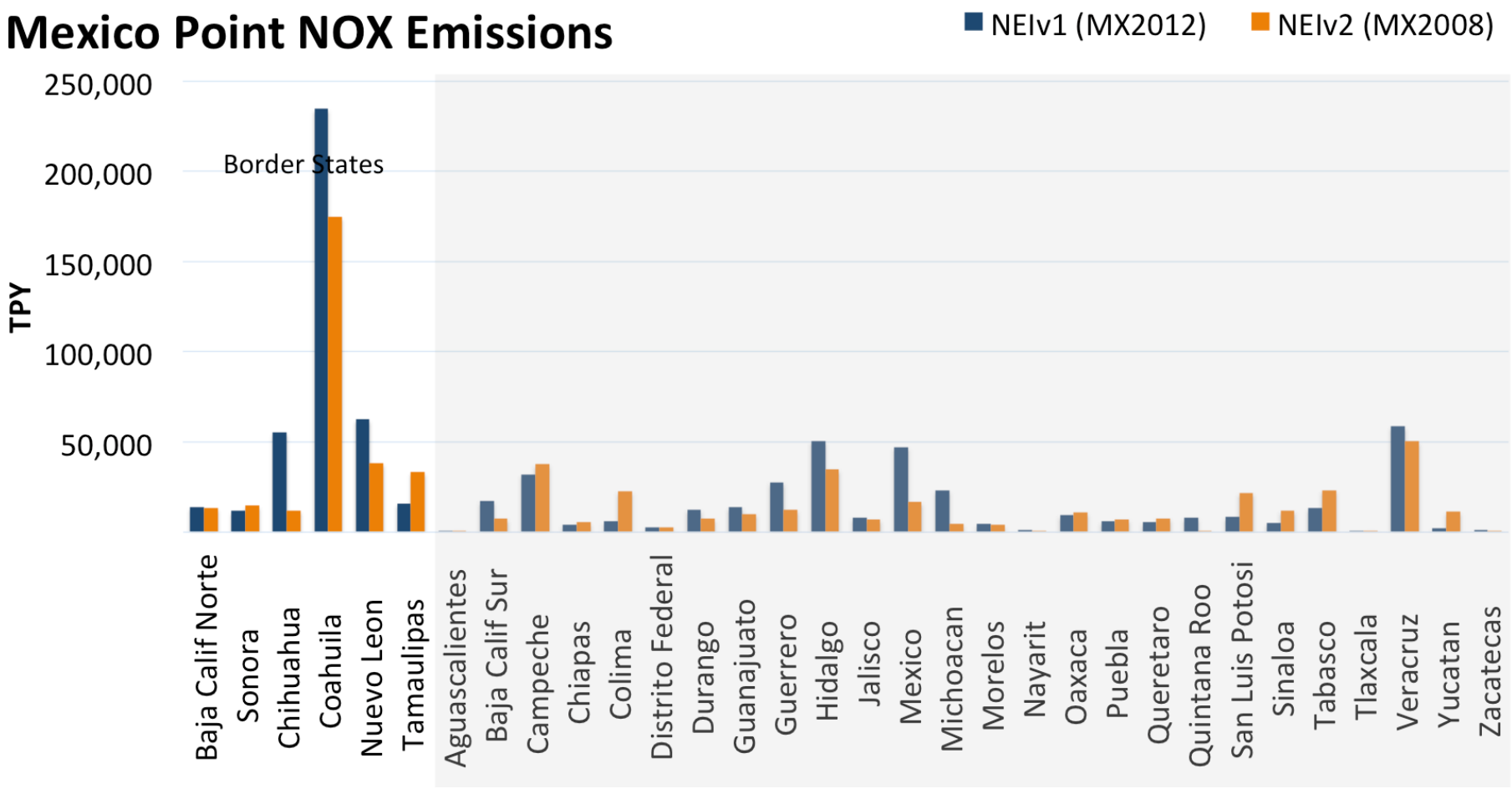

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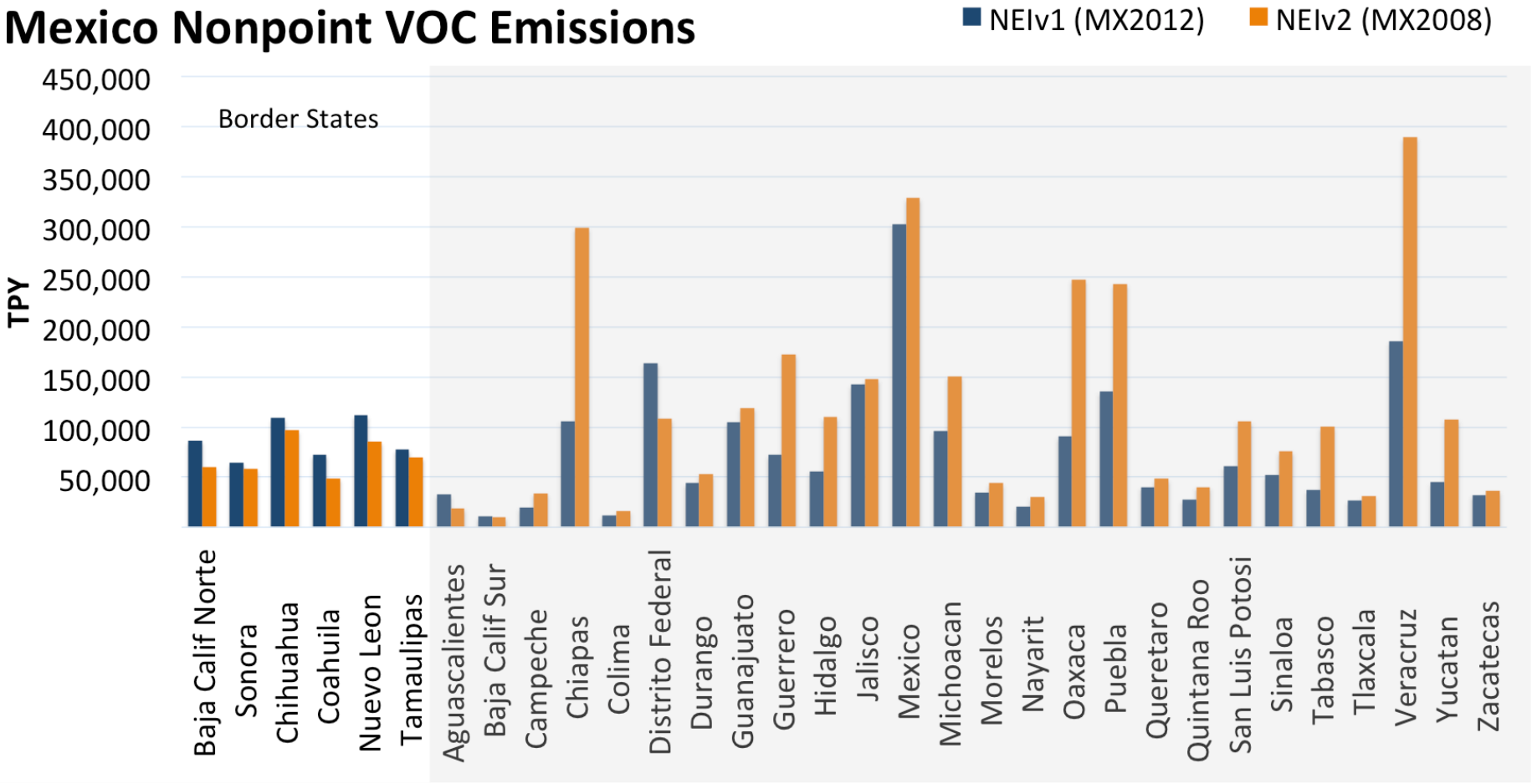

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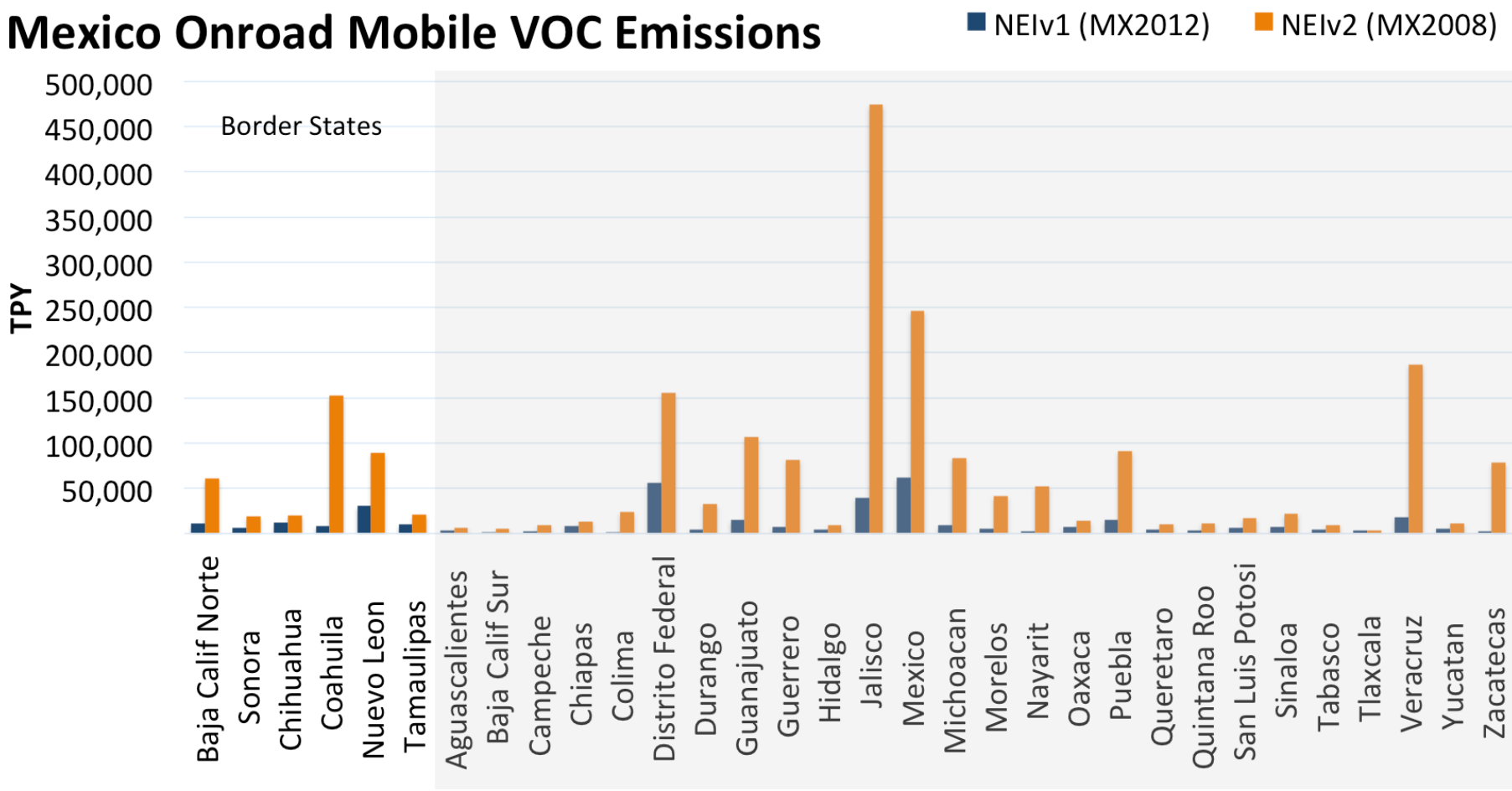

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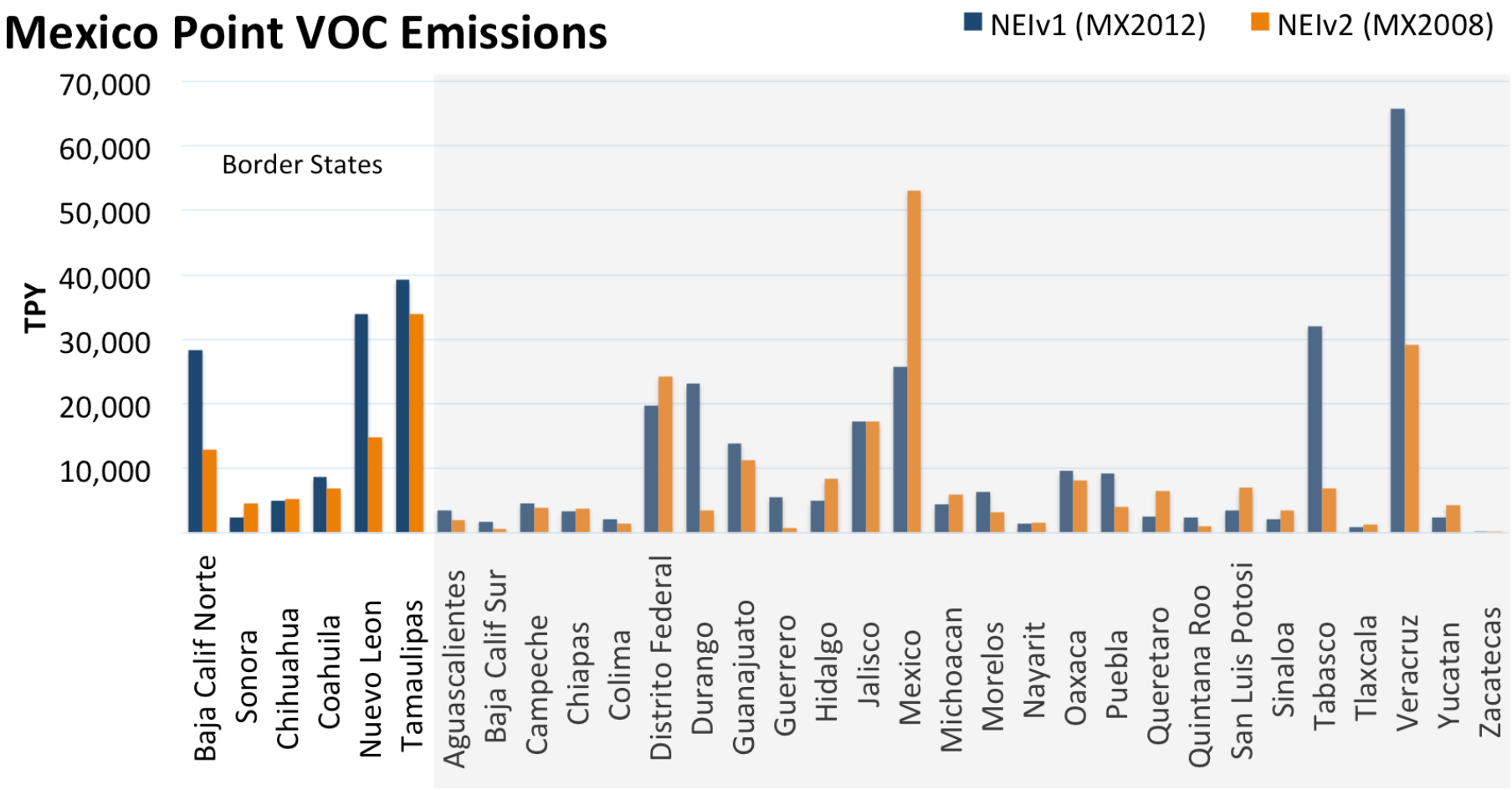
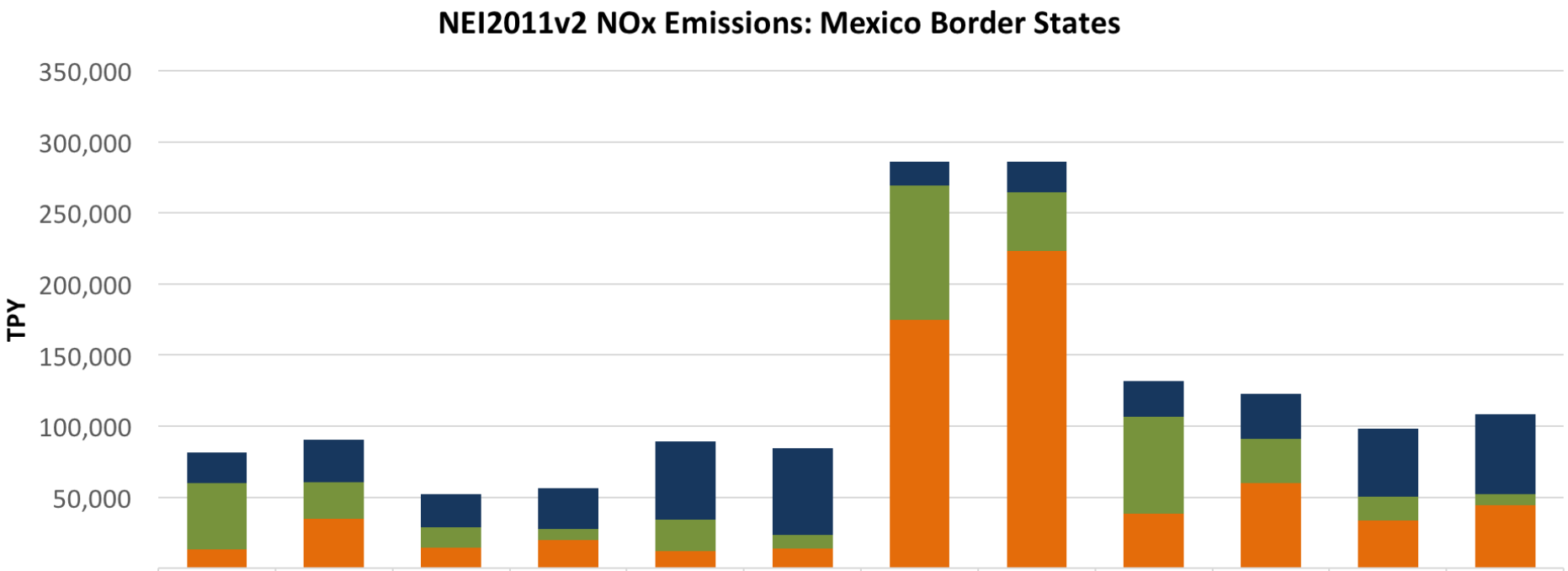


# Emissions Modeling Update

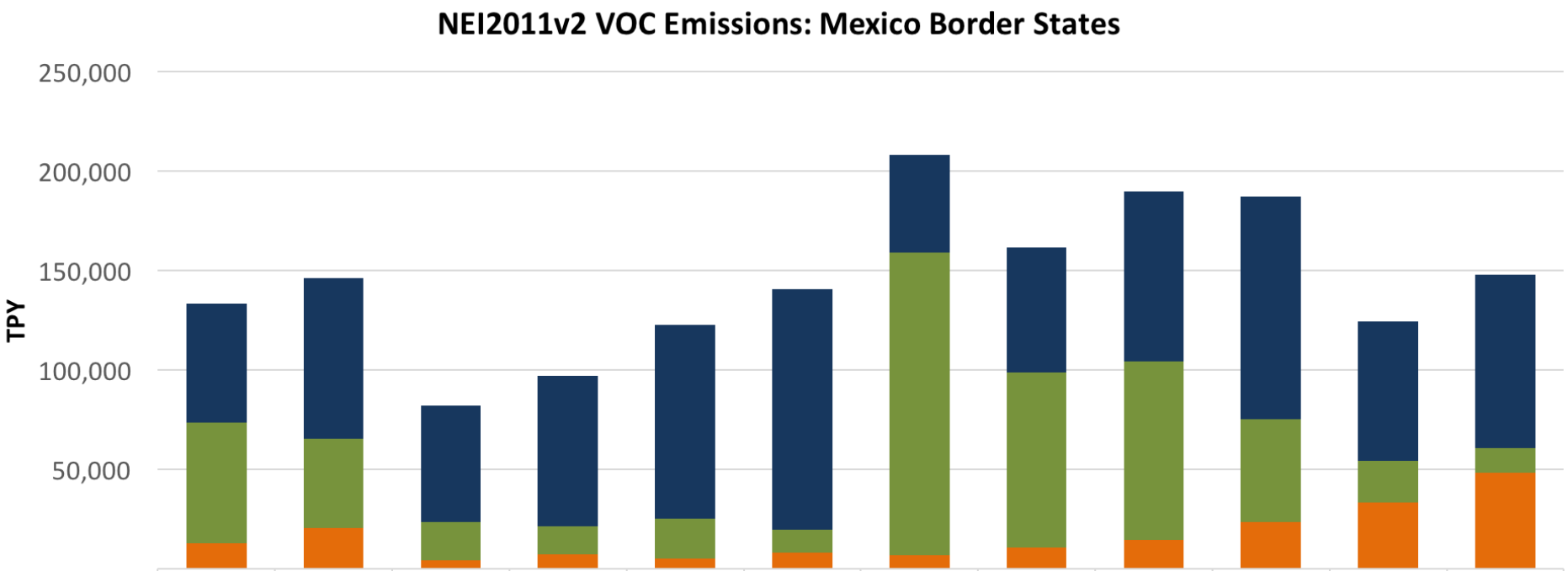
## Mexico Inventory Analysis: 2008 vs 2025




| | Baja Norte 08 | Baja Norte 25 | Sonora 08 | Sonora 25 | Chihuahua 08 | Chihuahua 25 | Coahuila 08 | Coahuila 25 | Nuevo Leon 08 | Nuevo Leon 25 | Tamaulipas 08 | Tamaulipas 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | 21,493 | 29,616 | 23,438 | 29,047 | 55,087 | 60,814 | 16,370 | 21,127 | 25,018 | 31,755 | 47,906 | 56,222 |
| Mobile | 46,346 | 25,769 | 14,338 | 7,568 | 21,893 | 10,121 | 94,558 | 41,640 | 68,375 | 31,026 | 17,073 | 7,876 |
| Point | 13,521 | 34,934 | 14,689 | 19,810 | 12,138 | 13,619 | 174,978 | 222,978 | 38,330 | 59,774 | 33,404 | 44,183 |

# Emissions Modeling Update

## Mexico Inventory Analysis: 2008 vs 2025

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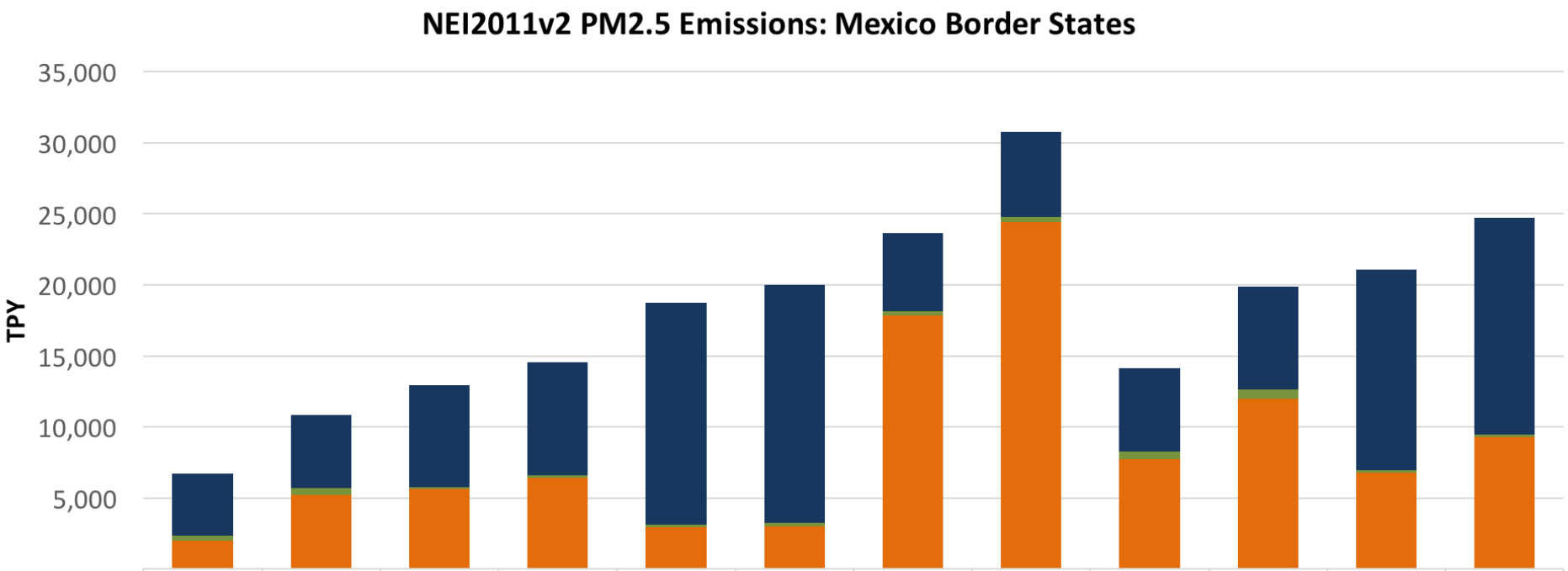
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | 60,078 | 81,036 | 58,422 | 75,485 | 97,197 | 120,858 | 49,052 | 62,857 | 85,480 | 112,230 | 70,068 | 87,327 |
| Mobile | 60,638 | 44,654 | 19,174 | 14,072 | 20,205 | 11,743 | 152,252 | 87,851 | 89,465 | 51,724 | 21,019 | 12,164 |
| Point | 12,886 | 20,655 | 4,511 | 7,470 | 5,223 | 8,253 | 6,833 | 10,936 | 14,872 | 23,453 | 33,404 | 48,594 |

# Emissions Modeling Update

## Mexico Inventory Analysis: 2008 vs 2025

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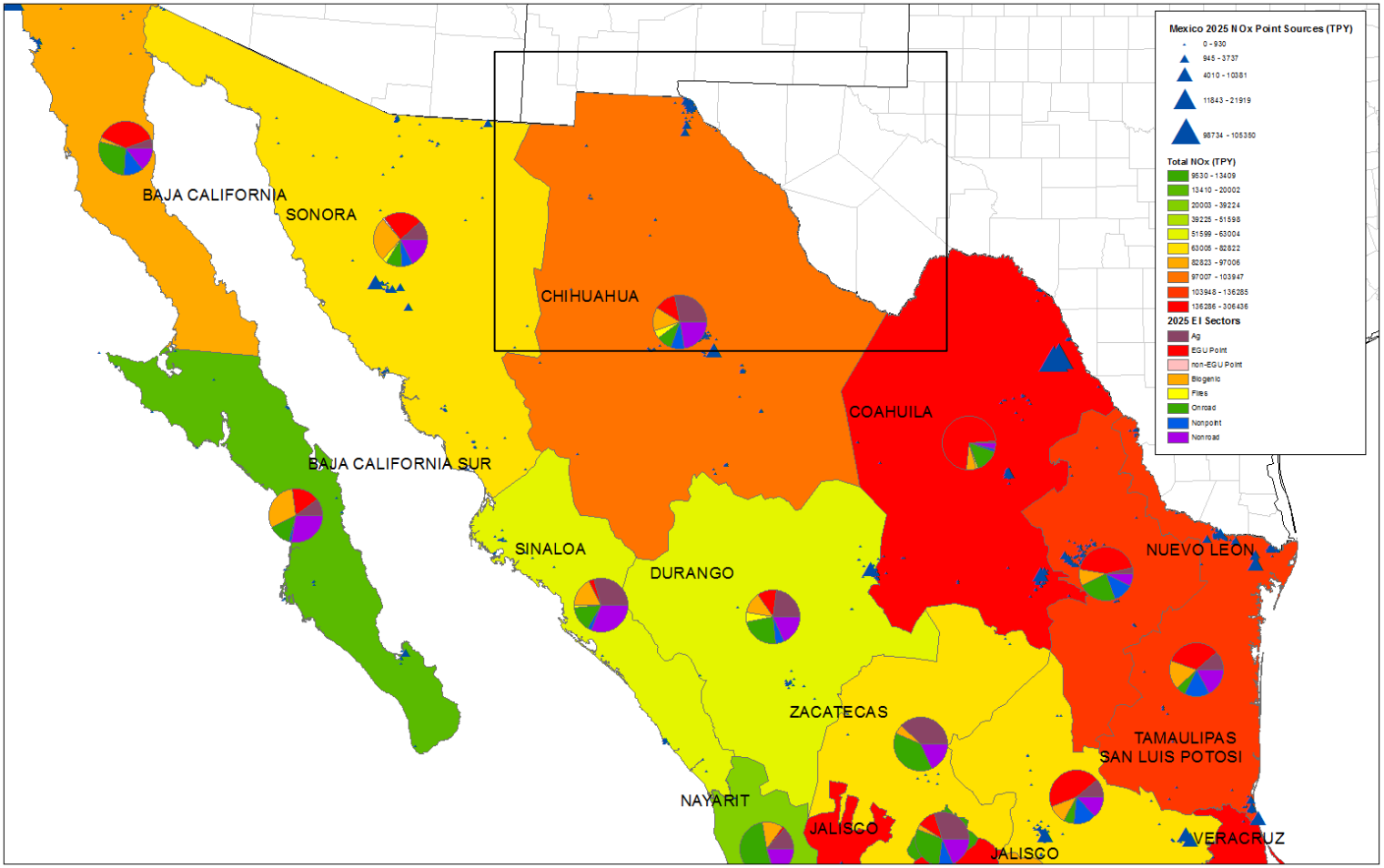
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | 4,370 | 5,141 | 7,156 | 7,976 | 15,590 | 16,752 | 5,518 | 5,941 | 5,877 | 7,264 | 14,136 | 15,250 |
| Mobile | 338 | 485 | 136 | 186 | 223 | 278 | 320 | 380 | 499 | 627 | 173 | 212 |
| Point | 2,025 | 5,235 | 5,636 | 6,408 | 2,925 | 2,988 | 17,822 | 24,425 | 7,756 | 12,000 | 6,785 | 9,276 |

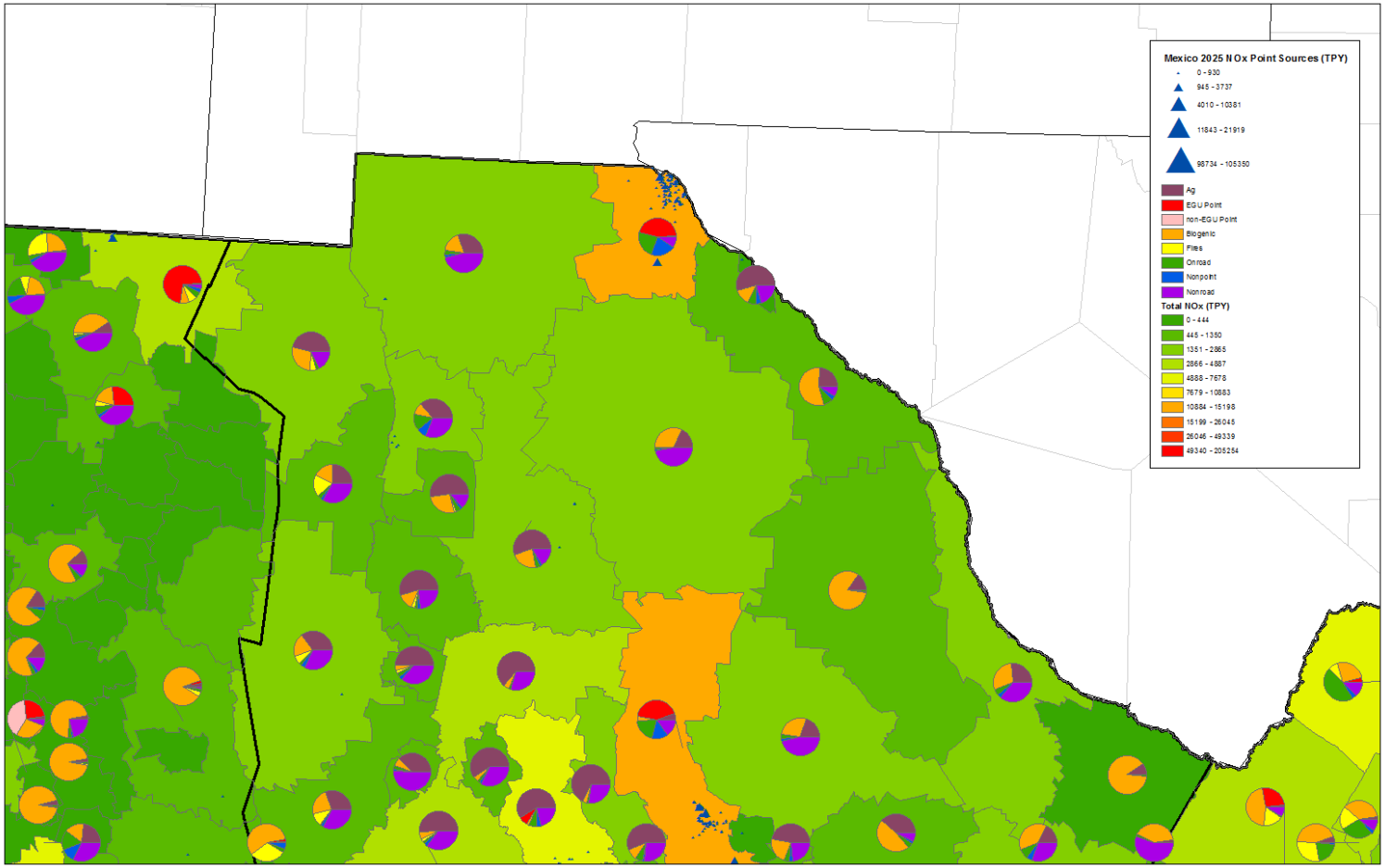
# Emissions Modeling Update

## Mexico Inventory Analysis: 2025 NOx Emissions



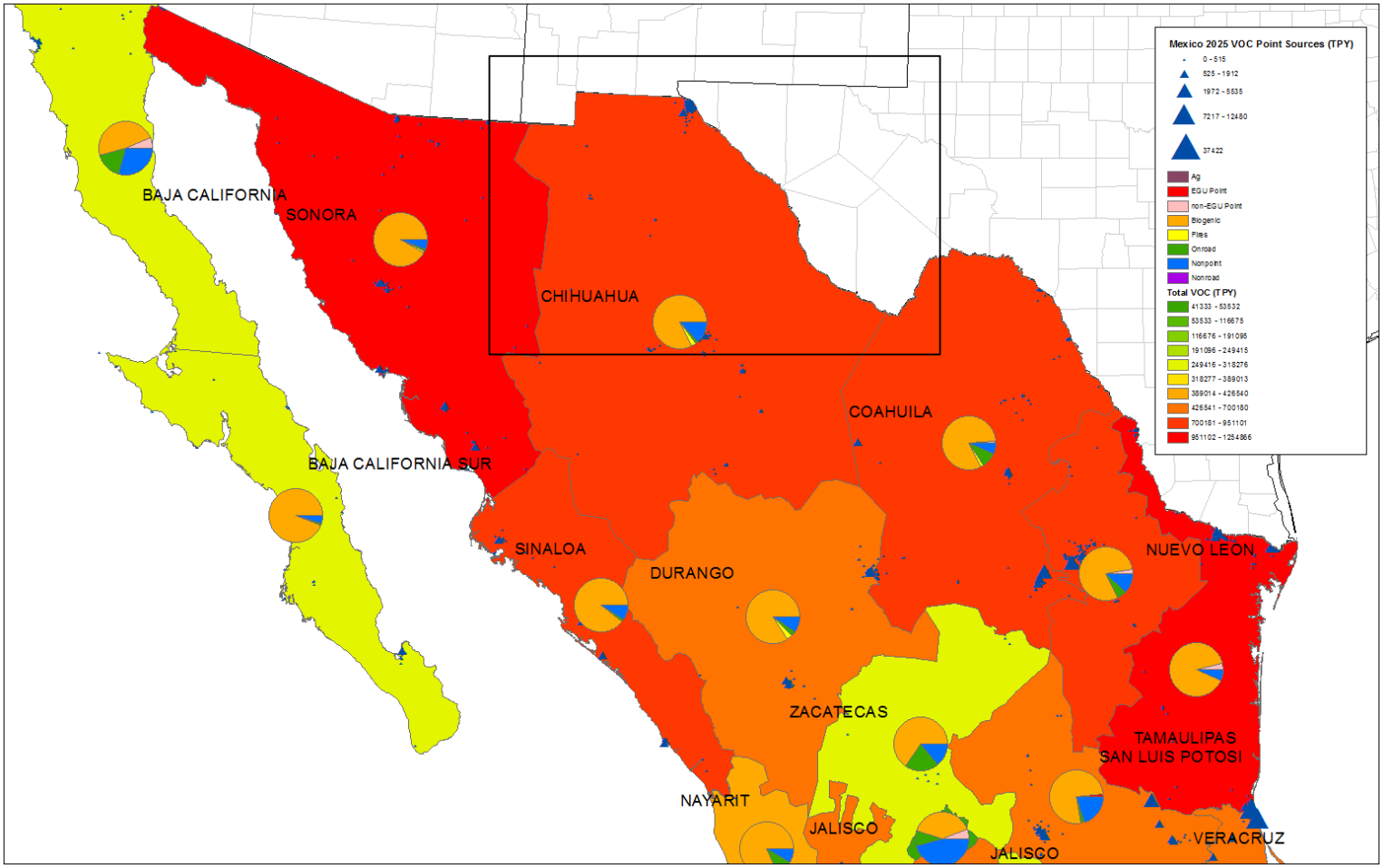
# Emissions Modeling Update

## Mexico Inventory Analysis: 2025 NOx Emissions



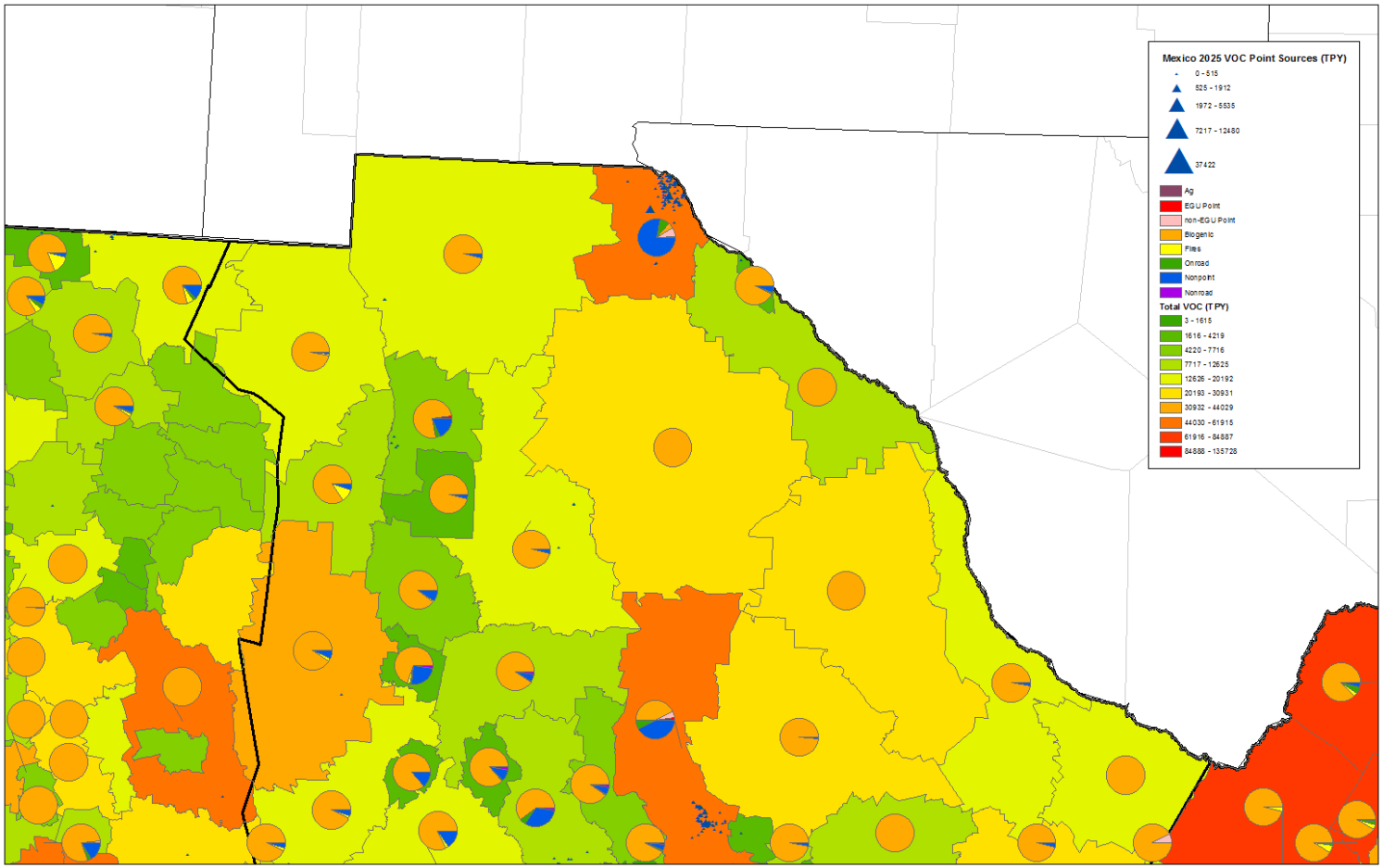
# Emissions Modeling Update

## Mexico Inventory Analysis: 2025 VOC Emissions



# Emissions Modeling Update

## Mexico Inventory Analysis: 2025 VOC Emissions



# Next Steps

- Documentation
  - Finalize Work Plan
- Meteorology
  - Complete WRF evaluation
  - Develop PPT for WRF MPE
- Emissions
  - Develop PPT for Permian Basin O&G emissions
  - Develop PPT for Mexico emissions