Temporally Allocating Emissions with CEM Data

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CEM – The Gold Standard

- Directly measured emissions
- Hourly Resolution
- Available for a significant fraction of the point source inventory

Why is CEM data seldom used?

- Large data sets
- Incomplete pollutant coverage
- Hard to select “typical” from among highly resolved data
- Matching CEM units to NIF objects is a significant challenge

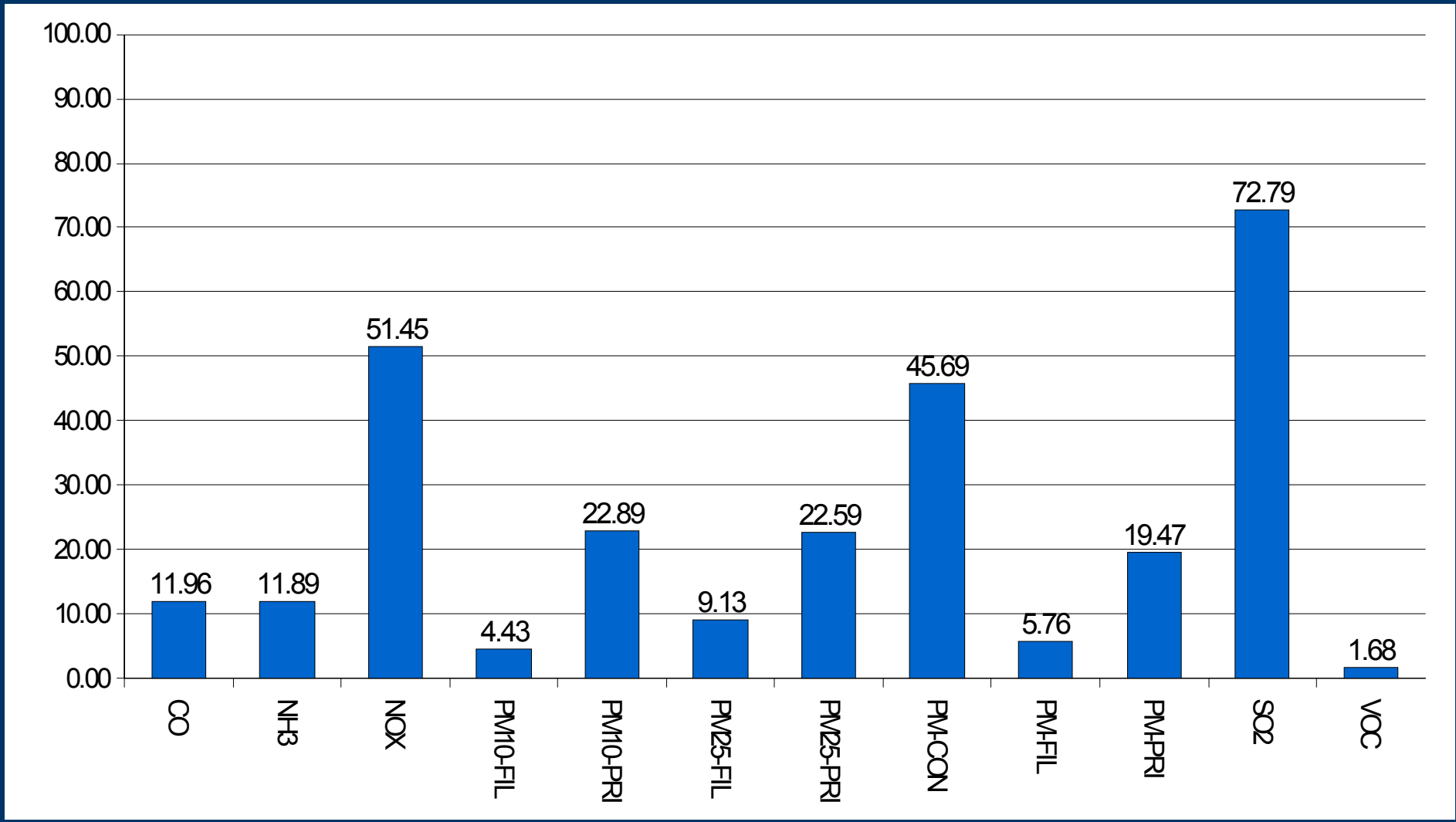
The Goal

- Unit-specific temporal profiles - monthly, weekday/Saturday/Sunday, and hourly
- Representative of typical period
  - Avoid effects of extremes of operation
  - Useful for base and future year
- Highly automated
  - Minimize resources required
  - Easy to apply to updated data
  - Easy to modify approach
- Output hour specific NIF emission records

Inputs

- 2001-2003 Quarterly CEM data compilations
- 2002 RPO point source inventory
- CEM to NIF cross reference from IPMTOOL

Percent of 2002 inventory that can be matched to CEM heat input data



Development of unit-specific profiles

- Based on median heat input
  - Eliminates effects of extremes of operation and upset events
  - Representative value for period
- Differs from textbook median
  - Assume missing data indicates no operation
  - Based on number of opportunities to report, not number of values reported

Example of selection of middle value

- 69 January weekdays in 2001- 2003
- Middle value would occupy 35th slot of sorted list
- Select all January weekday CEM heat input values for a specific unit and hour
- Sort descending and pick 35th value
- If fewer than 35 values exist, set middle value to zero, consistent with assumption that missing data implies no operation

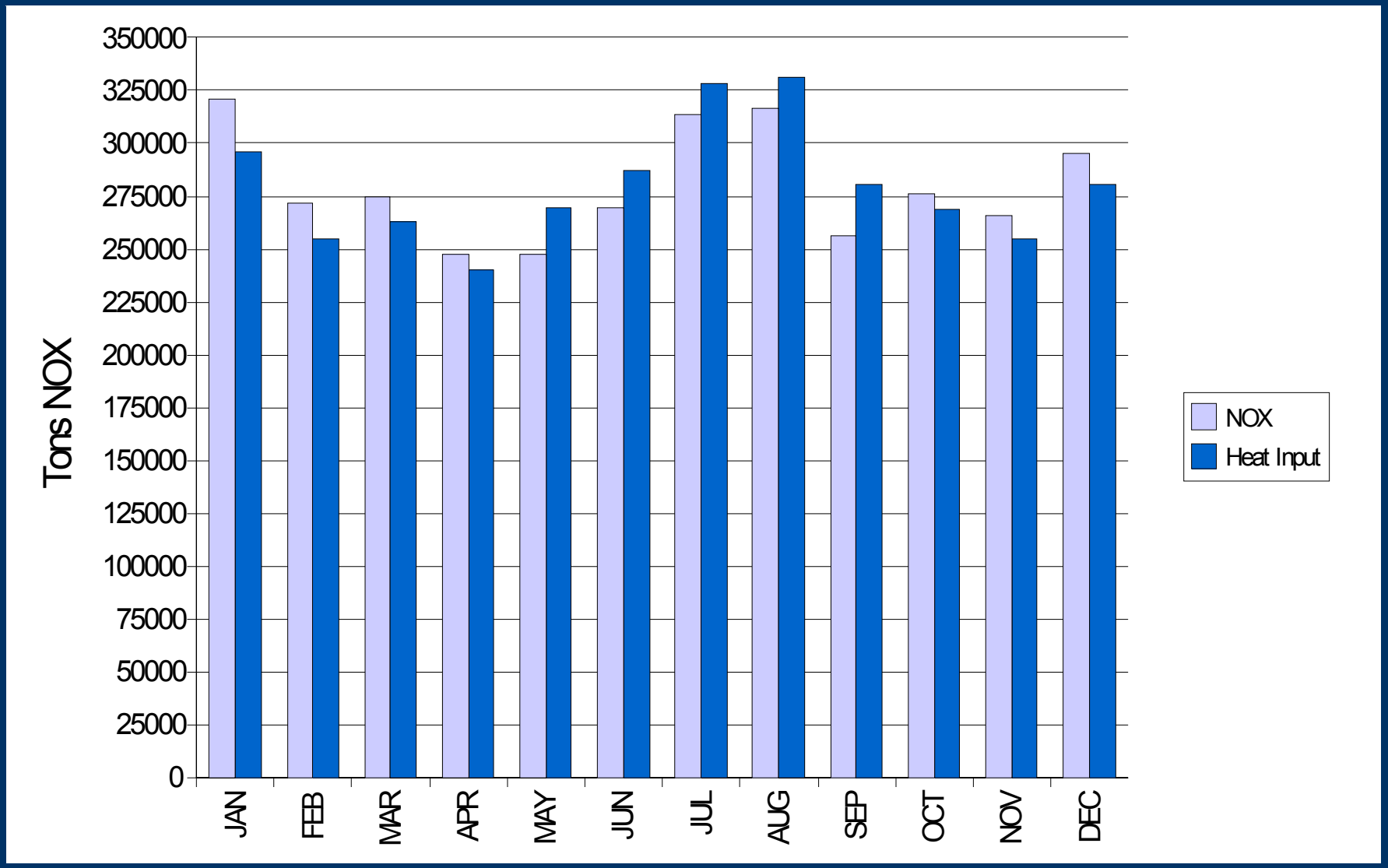
Completion of unit-specific profile

- Select 864 (12 months x 3 day types x 24 hours) middle values for each unit
- Generate unit-specific normalizing value by calculating heat input that would result if unit operated over 2002 at middle value appropriate for hour, day type and month
- Can adapt this approach to deal with periods other that annual (e.g. summer/non-summer IPM data) by normalizing to alternate periods

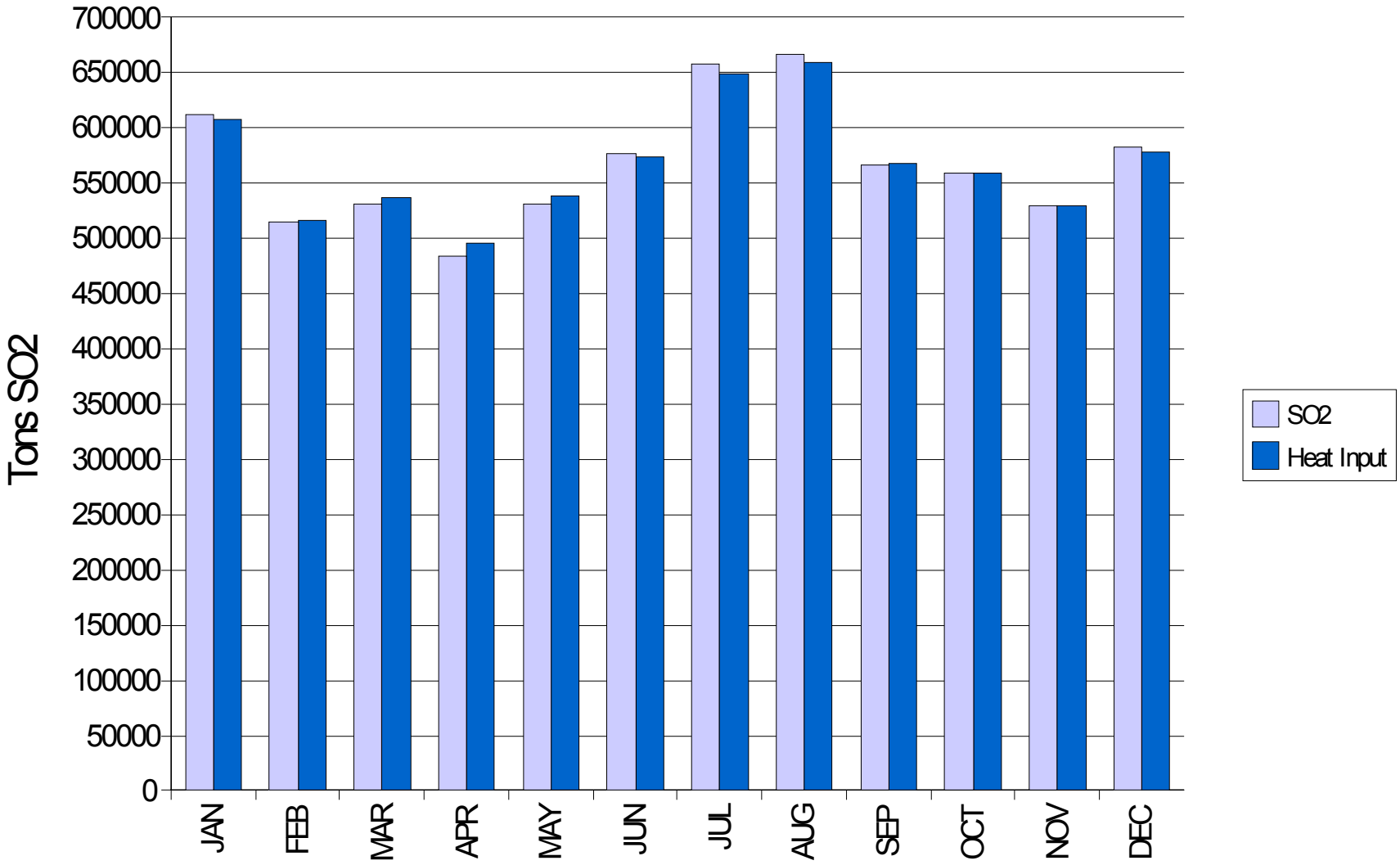
Matching profiles to NIF data

- Cross reference matches CEM units to NIF emission units, but is not always 1-to-1
- For one CEM unit to many NIF units, duplicate profile for each NIF unit
- For many CEM units to one NIF unit, aggregate across units within month/day type/hour to get heat input weighted composite profile
- Annual emissions * middle value / normalizing value = hourly emissions

Temporal distribution of 2002 CEM NOX emissions by CEM heat input vs. CEM NOX



Temporal distribution of 2002 CEM SO2 emissions by CEM heat input vs. CEM SO2

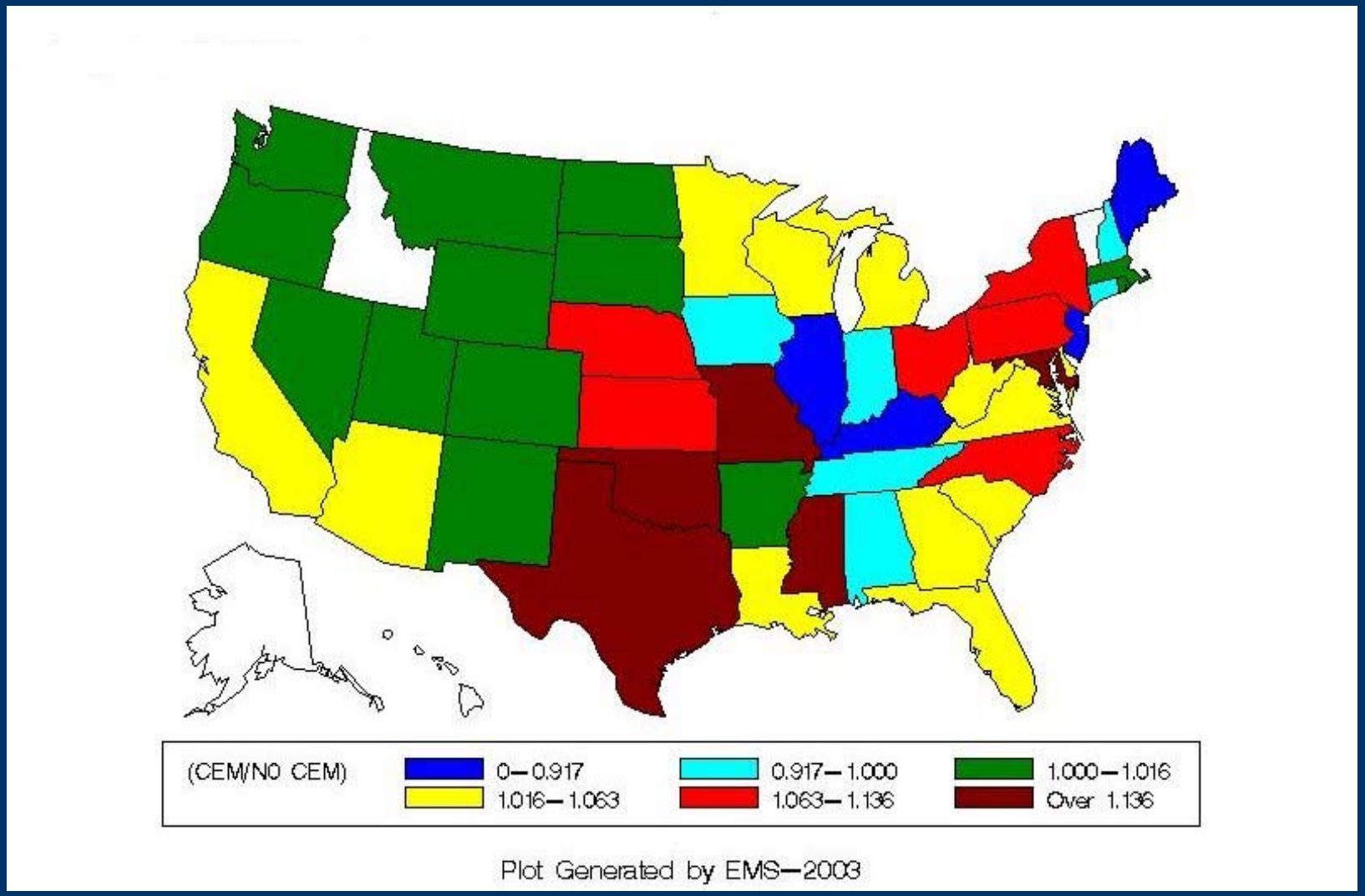


Another look at seasonal variation

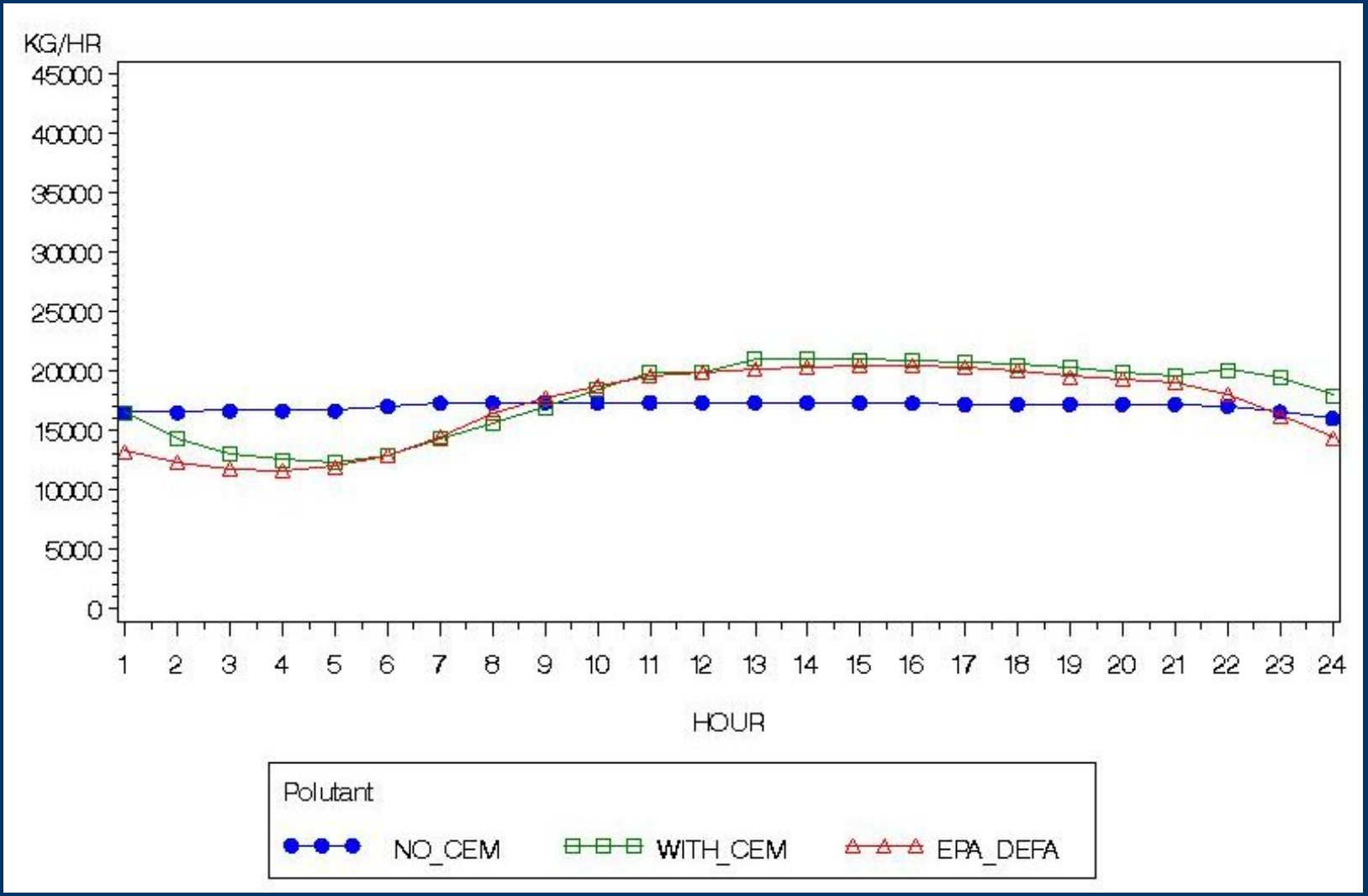
$$\sum_{u \in units} \sum_{m=Jan}^{Dec} \frac{\left| ht_{u,m} - poll_{u,m} \right| * E_u}{2}$$

- Calculate, by unit, fraction of inventory that would be allocated to a different month when switching between heat input and pollutant based allocation
- For NOx, 5.0% of inventory would be reallocated
- For SO2, 2.8%

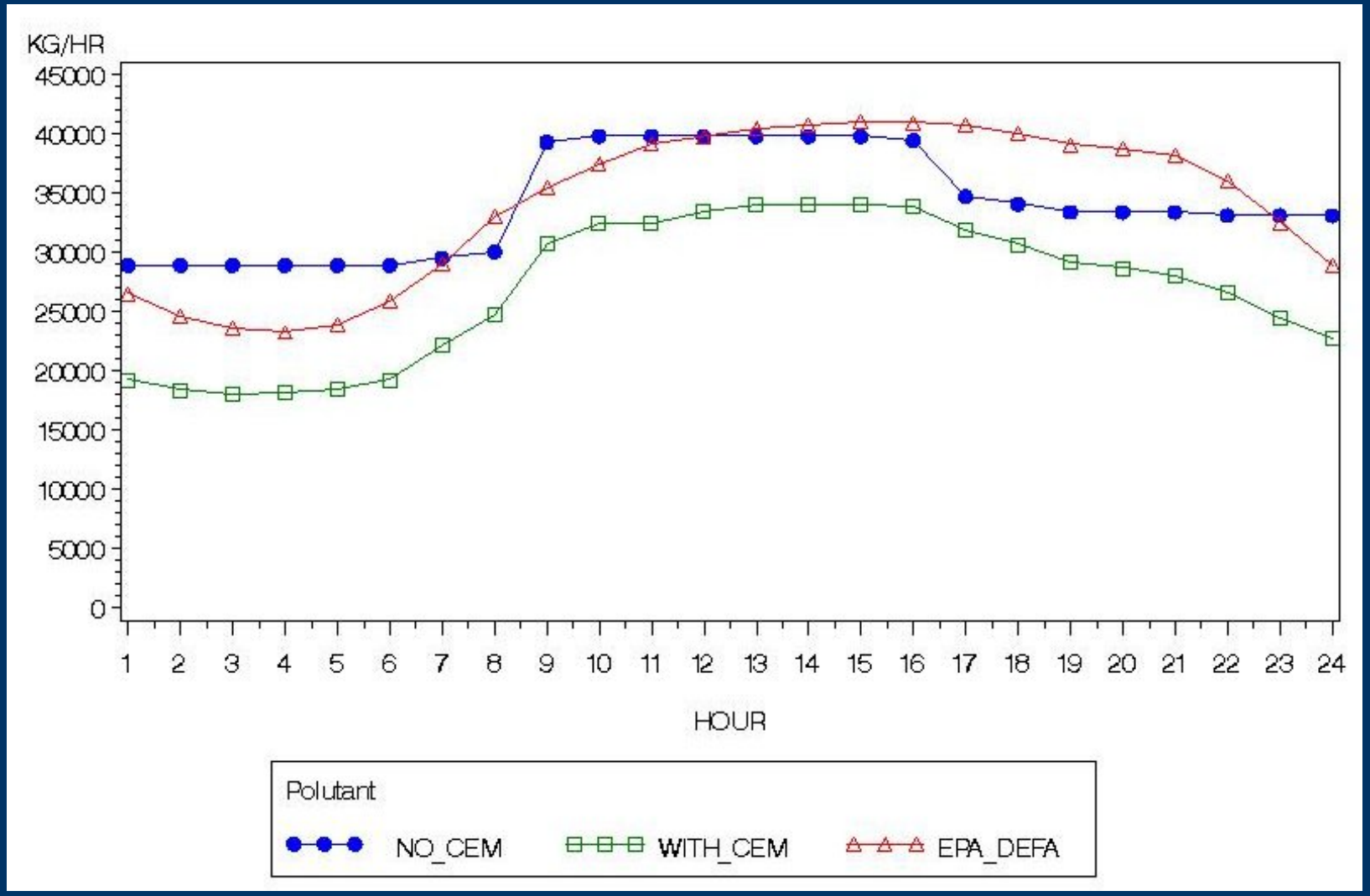
Ratio of July weekday EGU NOx with and without CEM based temporal allocation



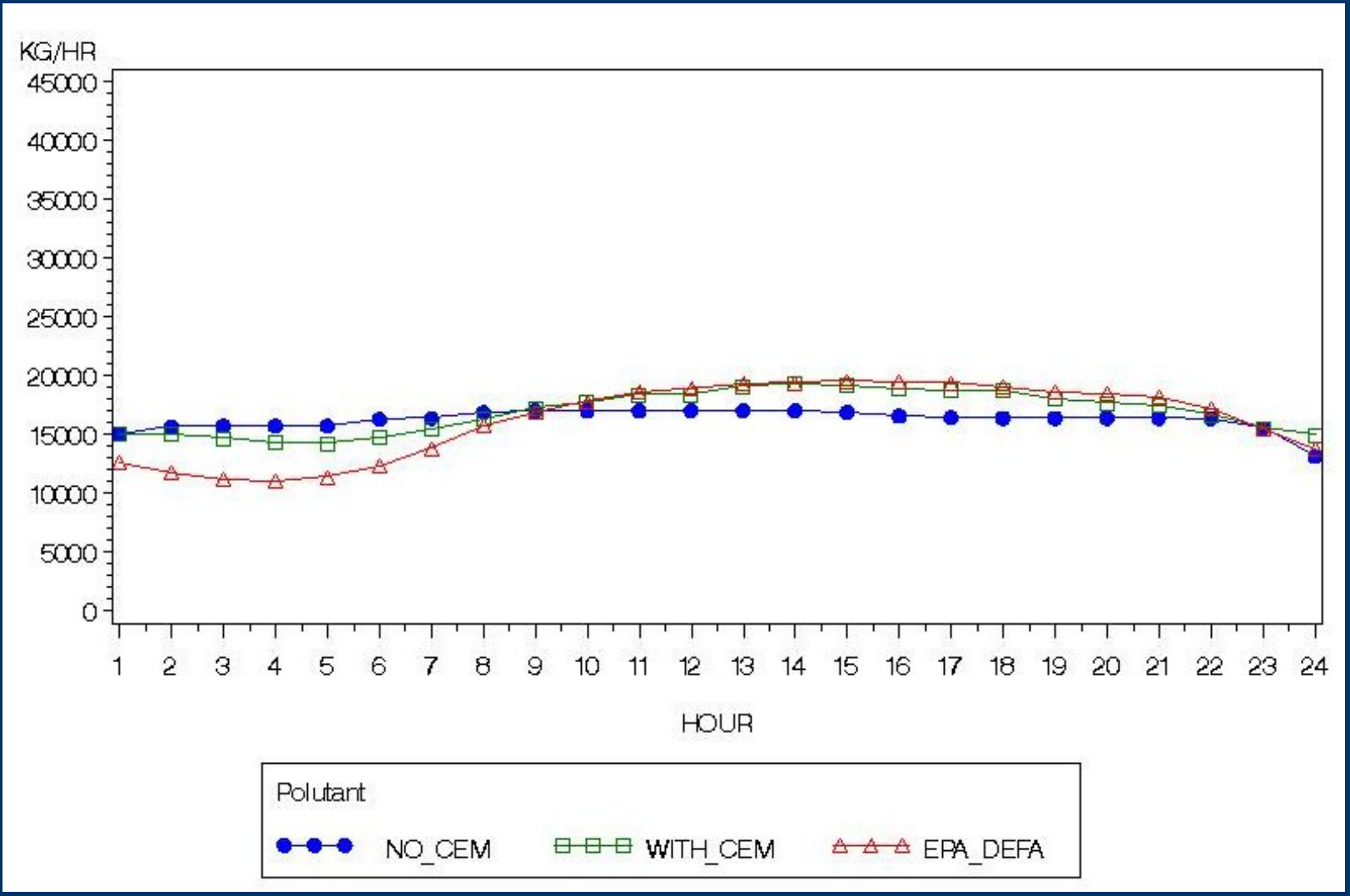
July 12, 2002 hourly NOx for Georgia EGUs



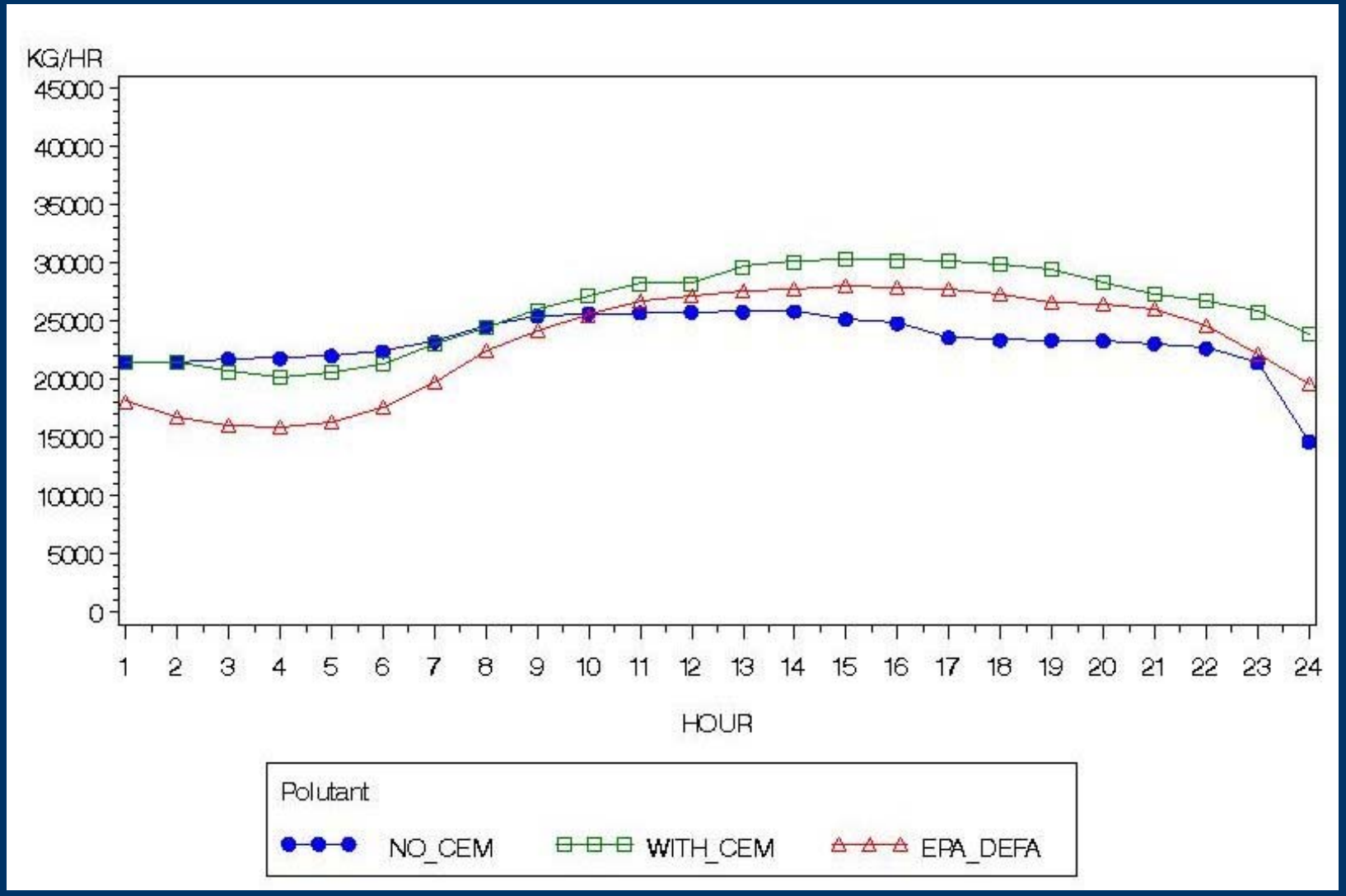
July 12, 2002 hourly NOx for Illinois EGUs



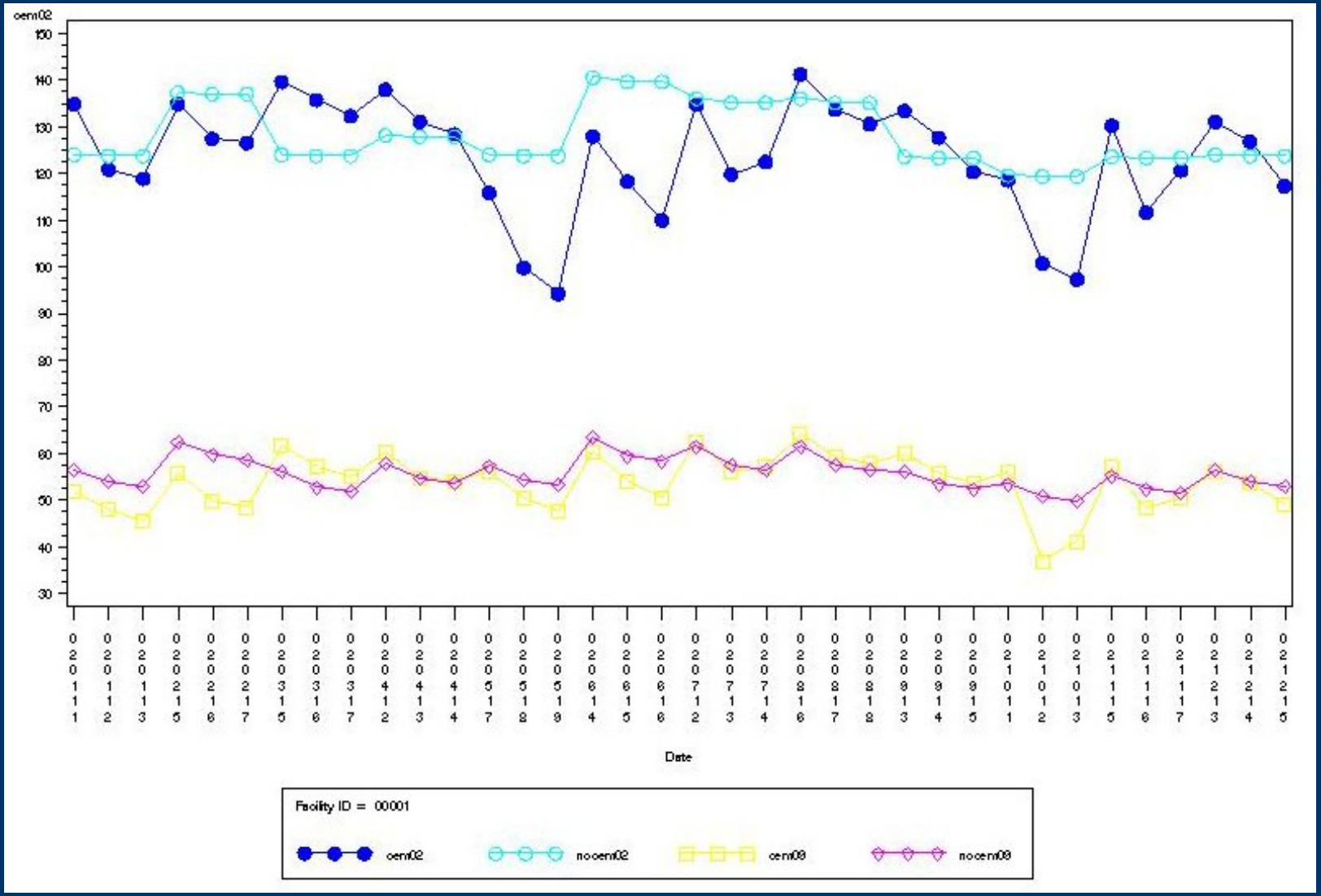
July 12, 2002 hourly NOx for Michigan EGUs



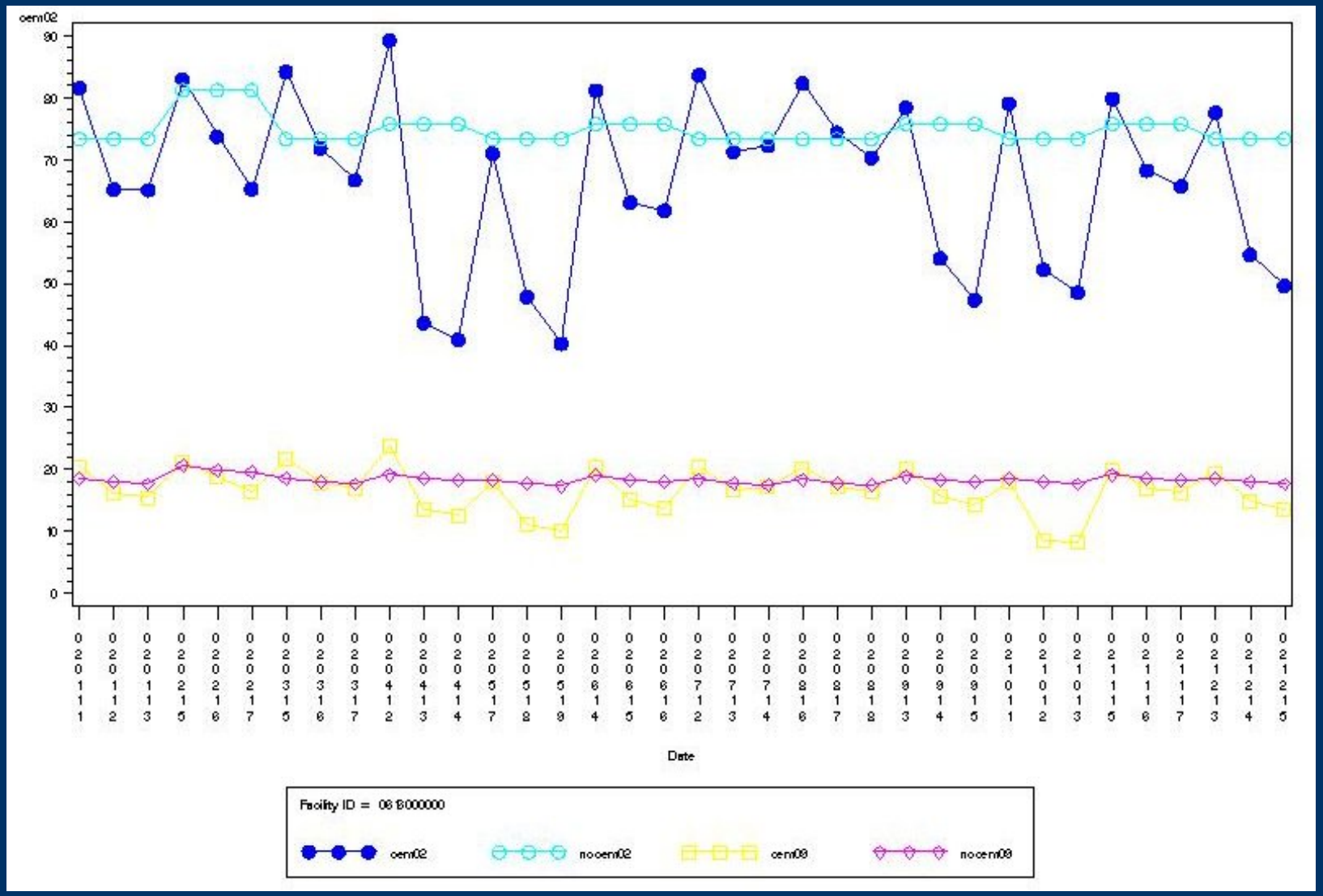
July 12, 2002 hourly NOx for Pennsylvania EGUs



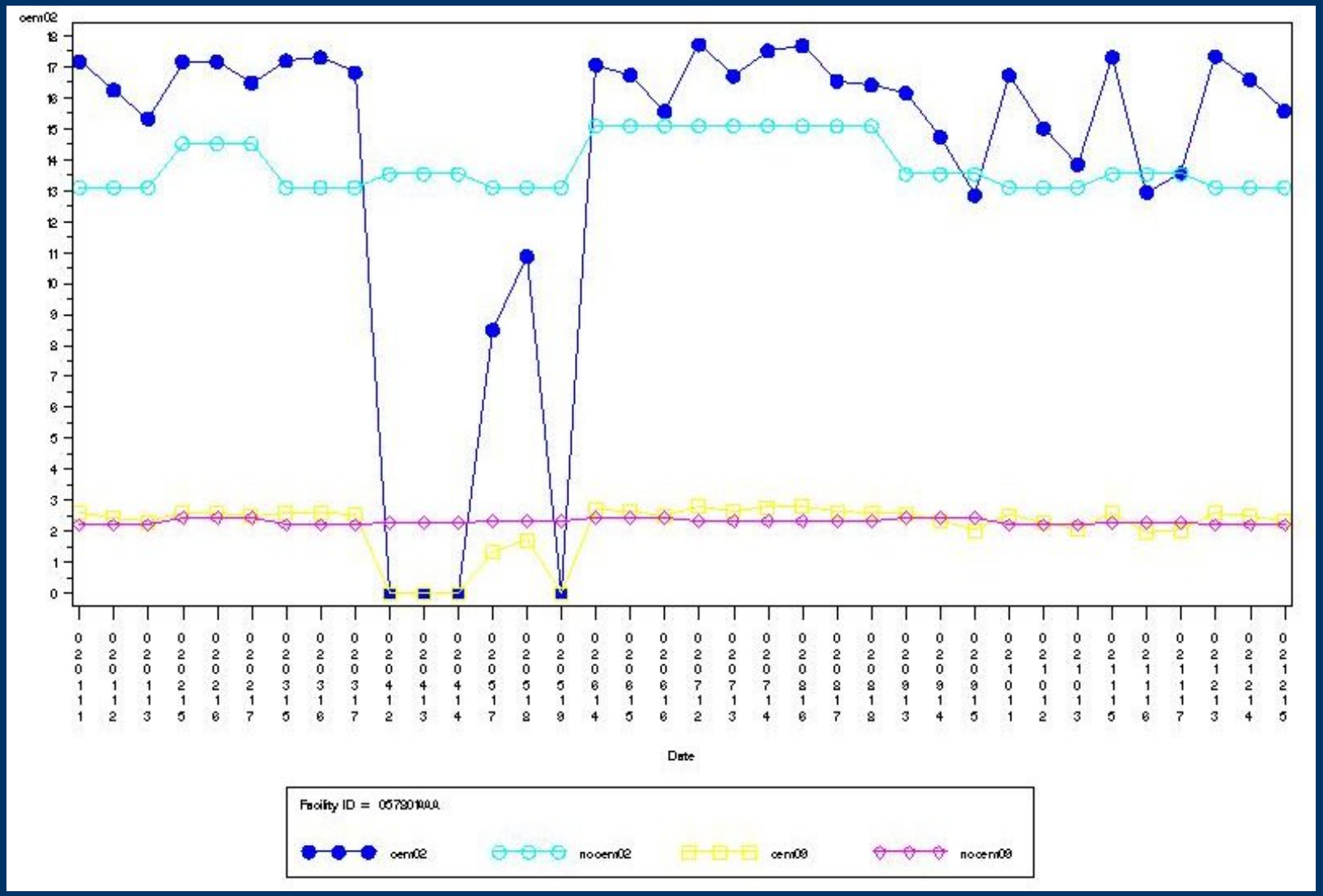
Even when overall correspondence is fair, 10-20 TPD differences can be common



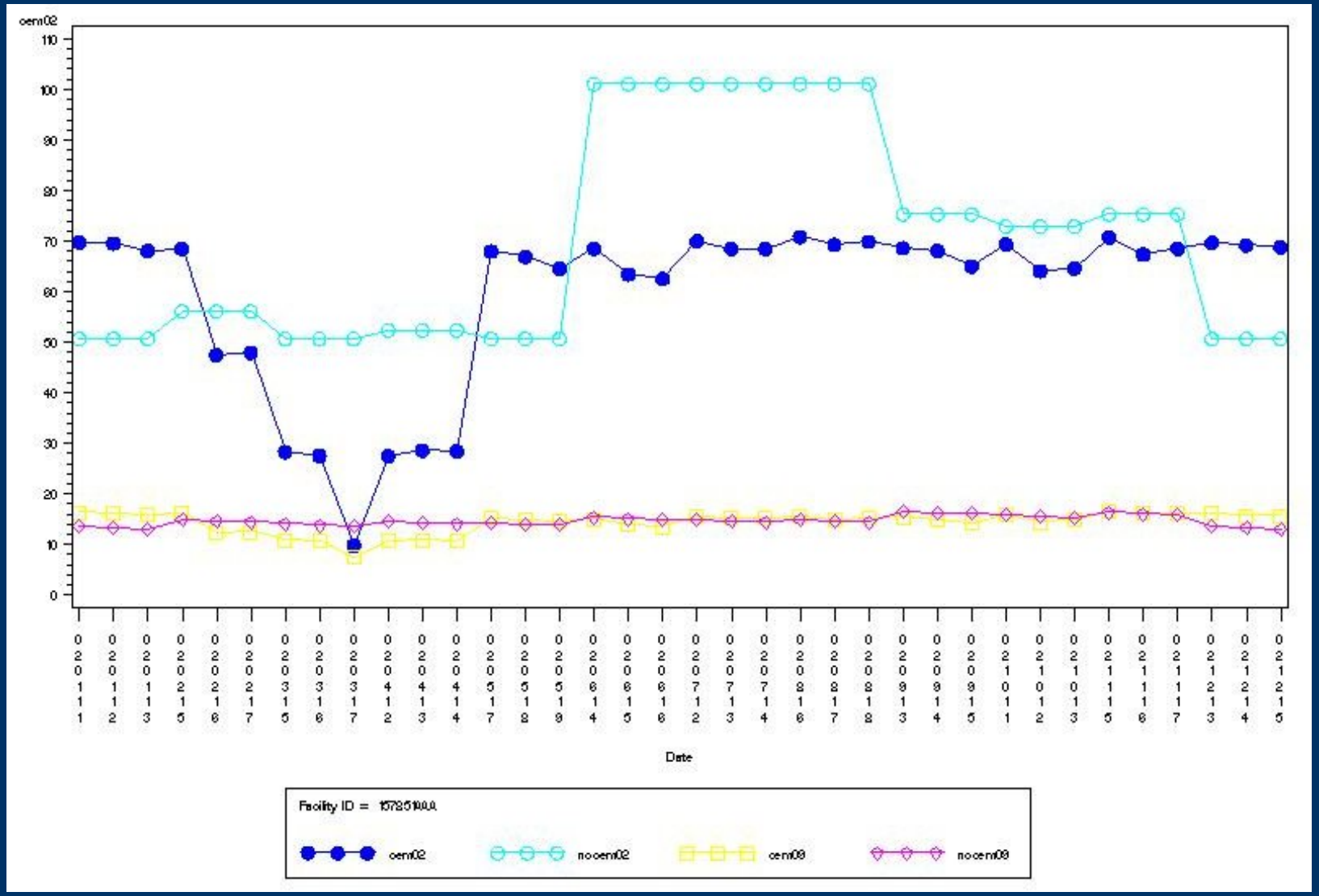
Significant weekday/weekend variation is apparent with CEM based temporal allocation



Median based approach over three years means this in not an upset event



CEM based temporal allocation can flatten the curve



Conclusions & Recommendations

- Improved temporal allocation results in significant changes to emissions
- Resource requirements are low for CEM based temporal allocation
  - From load of 88 million hourly CEM records to output of 13.7 million hourly NIF emission records takes less than 1 week on < $1000 computer
  - Most of the time is spent generating temporal profiles
  - Processing an updated inventory with existing profiles takes less than a day

Conclusions & Recommendations

- A large fraction of the point source inventory can be matched to CEM data
- Improved temporal only one of the improvements available from better EI-CEM integration
- An improved cross-reference, centrally located and cooperatively developed is the next step to realizing more benefit from CEM data