

# Emissions Processing of New Continuous Emissions Monitoring System (CEMS) Data Format

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# Updates to CAMD IT Systems

- EPA's Clean Air Markets Division (CAMD) is currently in a multi-year effort to reengineer IT systems for improved performance, security, and user-experience
- Clean Air Markets Program Data (CAMPD), the data publication application, was the first system released as part of this effort at <https://campd.epa.gov/>
- **The old Sparse Matrix Operating Kernel Emissions (SMOKE) formatted Continuous Emissions Monitoring Systems (CEMS) Data for each calendar year are no longer available**
- New format of CEMS data available at [Bulk Data Files](https://campd.epa.gov/data/bulk-data-files) under the "Emissions" data type, but the format is different (see: <https://campd.epa.gov/data/bulk-data-files>)

# CEMS Format Changes

## Old SMOKE CEMS Data Format

```
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```

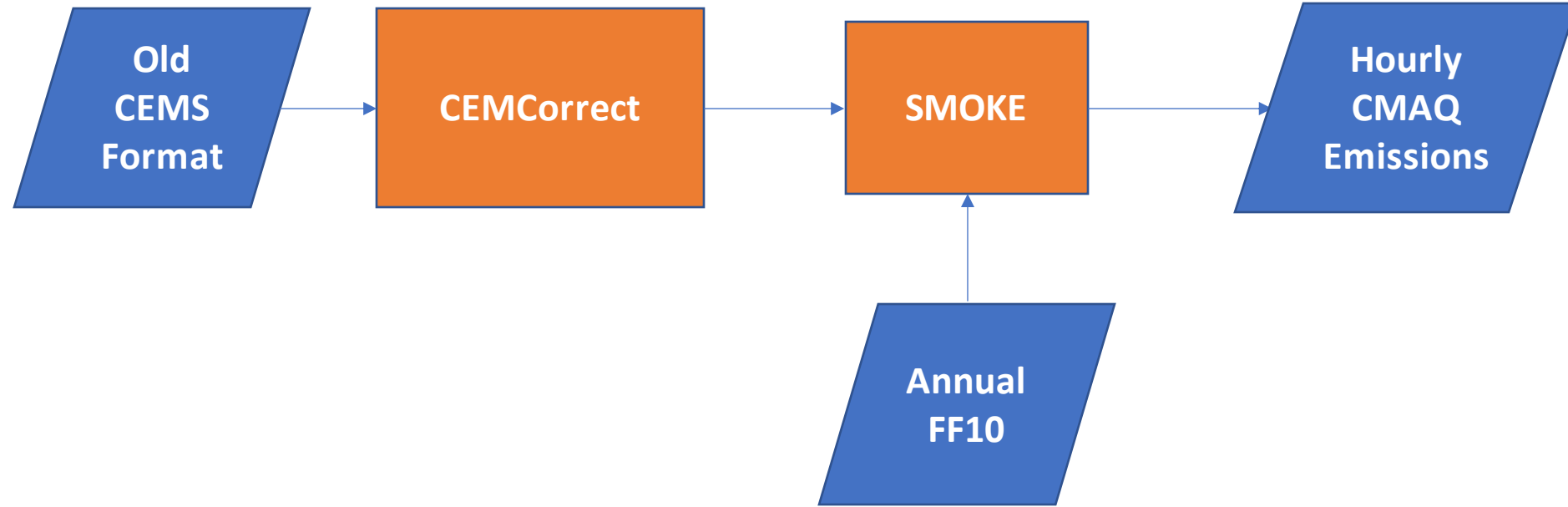
The old format can be read by the SMOKE programs smkinven and CEMScan and the tool CEMCorrect

The new format is more descriptive but not natively compatible with SMOKE or CEMCorrect

## New CEMS data Format

```
"State","Facility Name","Facility ID","Unit ID","Associated Stacks","Date","Hour","Operating Time","Gross Load (MW)","Steam Load (1000 lb/hr)","SO2 Mass (lbs)","SO2 Mass Measure Indicator","SO2 Rate (lbs/mmBtu)","SO2 Rate Measure Indicator","NOx Mass (lbs)","NOx Mass Measure Indicator","NOx Rate (lbs/mmBtu)","NOx Rate Measure Indicator","CO2 Mass (short tons)","CO2 Mass Measure Indicator","CO2 Rate (short tons/mmBtu)","CO2 Rate Measure Indicator","Heat Input (mmBtu)","Primary Fuel Type","Secondary Fuel Type","Unit Type","SO2 Controls","PM Controls","NOx Controls","Hg Controls","Program Code"
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"AL","Barry",3,"1","CSOAN","2016-06-15",22,1,4,,3.75,"Measured",0.049,"Calculated",0.3,"Measured",0.004,"Calculated",4.5,"Measured",0.059,"Calculated",76.3,"Pipeline Natural Gas",,"Tangentially-fired",,"Low NOx Burner Technology w/ Closed-coupled OFA,Selective Non-catalytic Reduction",,"ARP, CSNOX, CSNOXOS, CSSO2G2"
"AL","Barry",3,"1","CSOAN","2016-06-15",23,1,4,,3.75,"Measured",0.069,"Calculated",0.25,"Measured",0.005,"Calculated",3.2,"Measured",0.059,"Calculated",54,"Pipeline Natural Gas",,"Tangentially-fired",,"Low NOx Burner Technology w/ Closed-coupled OFA,Selective Non-catalytic Reduction",,"ARP, CSNOX, CSNOXOS, CSSO2G2"
"AL","Barry",3,"1","CSOAN","2016-06-16",0,1,4,,3.85,"Measured",0.043,"Calculated",1,"Measured",0.011,"Calculated",5.3,"Measured",0.059,"Calculated",89.6,"Pipeline Natural Gas",,"Tangentially-fired",,"Low NOx Burner Technology w/ Closed-coupled OFA,Selective Non-catalytic Reduction",,"ARP, CSNOX, CSNOXOS, CSSO2G2"
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```

# Emissions Processing for Old CEMS

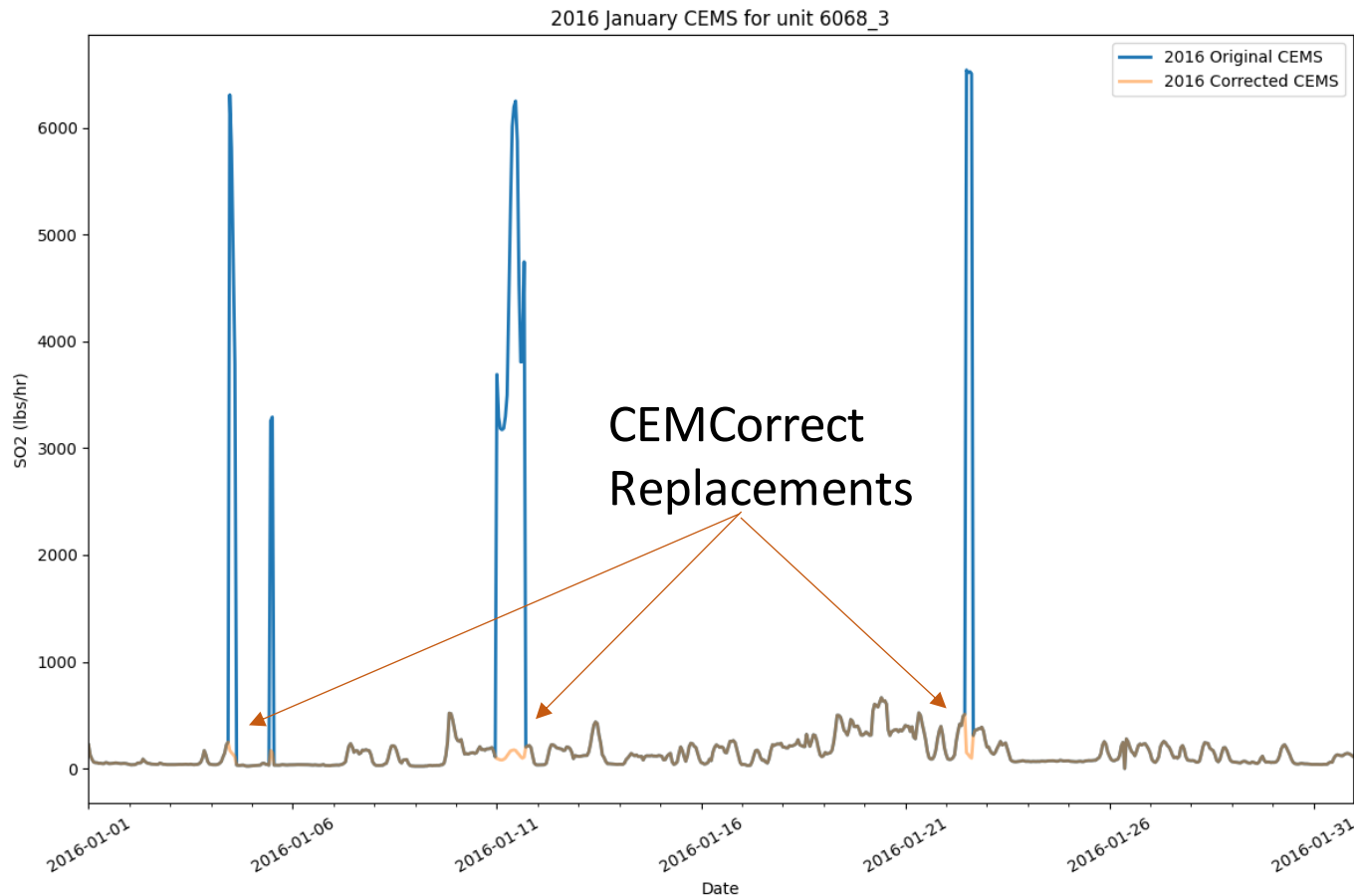


- Hourly CEMS data contains NOX, SO2, and heat input at the ORIS unit level (new format contains CO2)
- SMOKE uses CEMS data to replace NOX and SO2 by unit and temporally allocate other pollutants in the annual emissions inventory flat file (FF10) using heat input
  - “Black box” internal mapping of FF10 unit codes to CEMS/ORIS unit codes
- Quality assurance difficult because input annual FF10 does not contain the same NOX and SO2 emissions values as the CMAQ model ready files
- New CEMS format an opportunity to improve EGU emissions processing methods

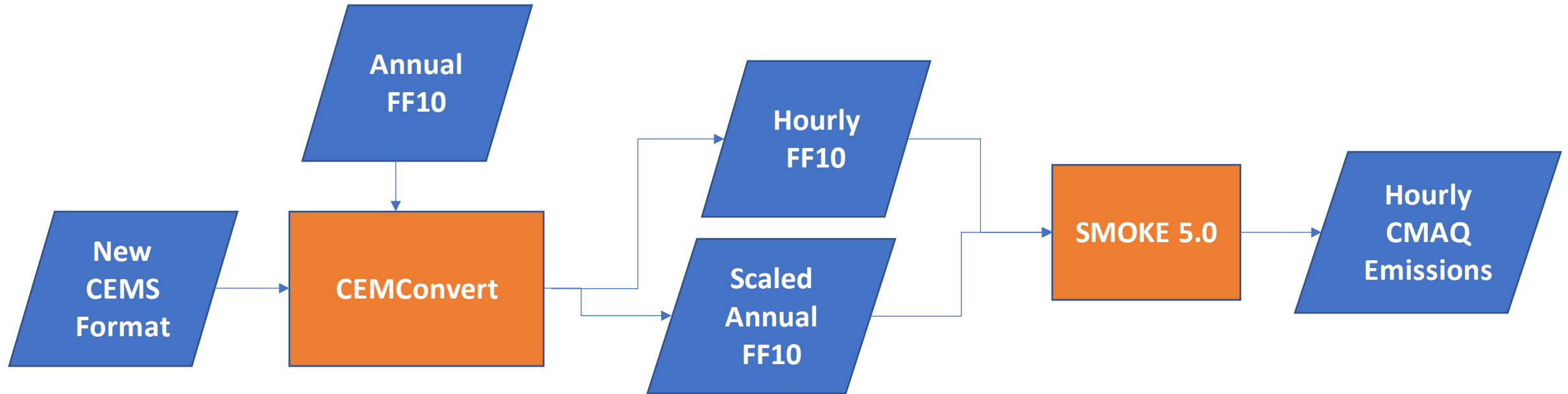
# CEMCorrect

- CEMCorrect replaces anomalous CEMS values with hourly means
- Formerly stand-alone tool, now integrated into CEMConvert

Example plot shows anomalous **blue** peaks replaced by **orange** mean values



# Emissions Processing for New CEMS



- FF10 hourly format aligns with inventory format of other emissions sectors
- CEMS to FF10 unit mapping done by CEMConvert and reflected in hourly and annual FF10s
- NOX, SO2, and CO2 CEMS summed annual values replace annual FF10 unit values where units are matched to CEMS; HOURACT variable represents hourly activity (eg. heat input)
- Quality assurance simpler and more reliable because annual FF10 values match post-SMOKE model ready emissions values

# CEMConvert Preprocessor

- Open source Python tool available on github:  
<https://github.com/USEPA/CEMConvert>
- Scales annual FF10 to hourly CEMS (base year) or hourly values to annual FF10 (Future Year/IPM)
- Can temporalize nonCEMS annual values (e.g. VOC or PM25) using HOURACT/Heat Input directly into hourly FF10 format
- Now incorporates **CEMCorrect!**
- Example scripts available for retrieving 2021 CEMS and preparing emissions for SMOKE modeling

# Conclusions and Next Steps

- CEMConvert simplifies the processing stream and quality assurance for emissions sources with CEMS under the new CAMD format
- Use of the FF10 flat file format allows for potential integration of hourly CEMS at non-EGU sources
- Improvements to CEMCorrect algorithm may still be needed
  - Use of monthly or seasonal means in place of annual when replacing values
  - Calculate rates using operating hours
  - Correct all data that exceeds the threshold, not just flagged data
  - Use hour-specific heat input for mean emissions rate calculations



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