High Electric Demand Day (HEDD) Emissions Analysis for O3 Modeling

Dave Wackter, CTDEP
SIPRAC Meeting September 10, 2009

From presentation provided at
EPA Photochemical Modeling Workshop
Annapolis, MD
June 17, 2009

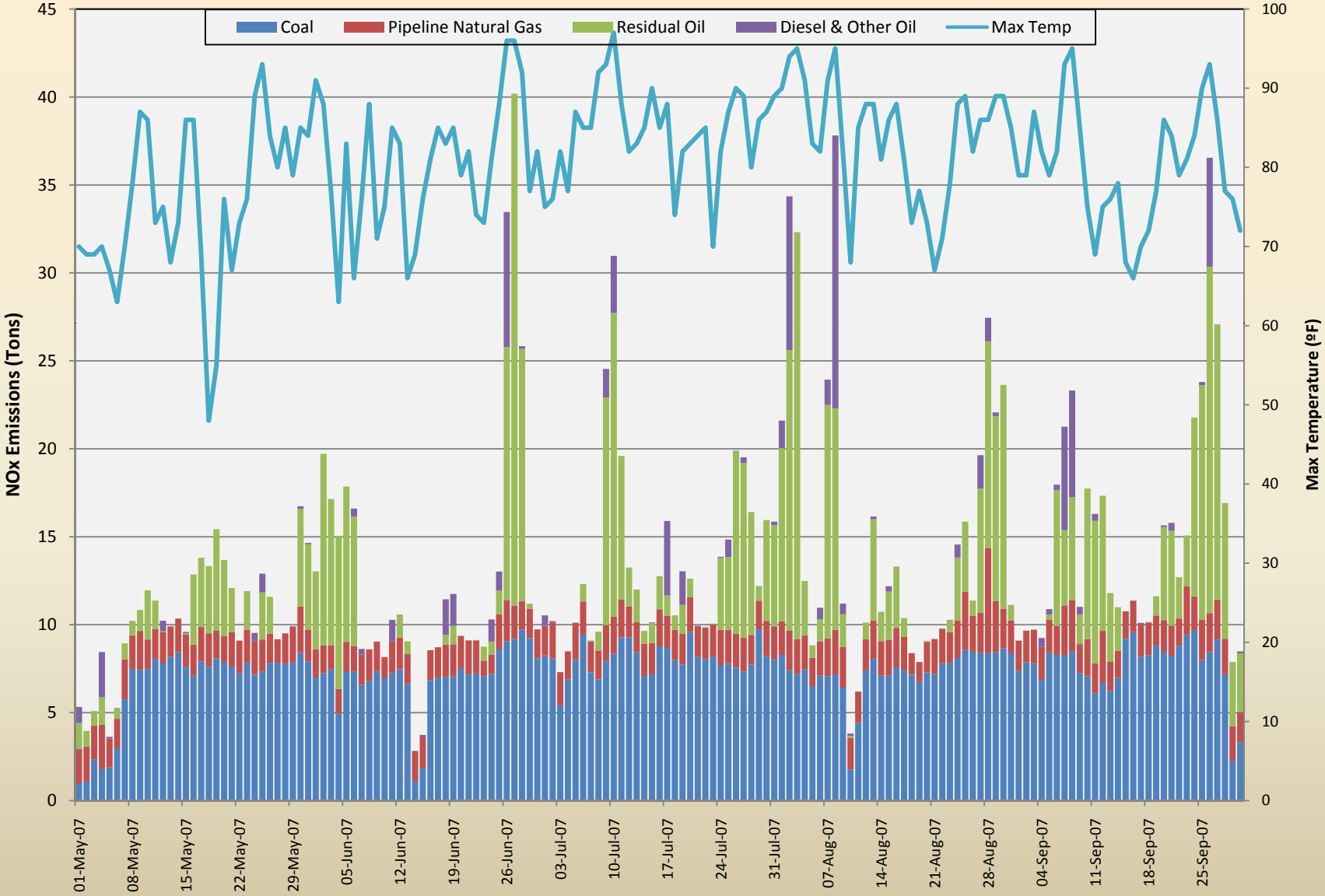
The Issues

- EGU operations and associated NOx emissions are variable in space and time
- Photochemical modeling for the 2006 O3 NAAQS attainment demonstrations should incorporate such EGU emissions variability

These Slides

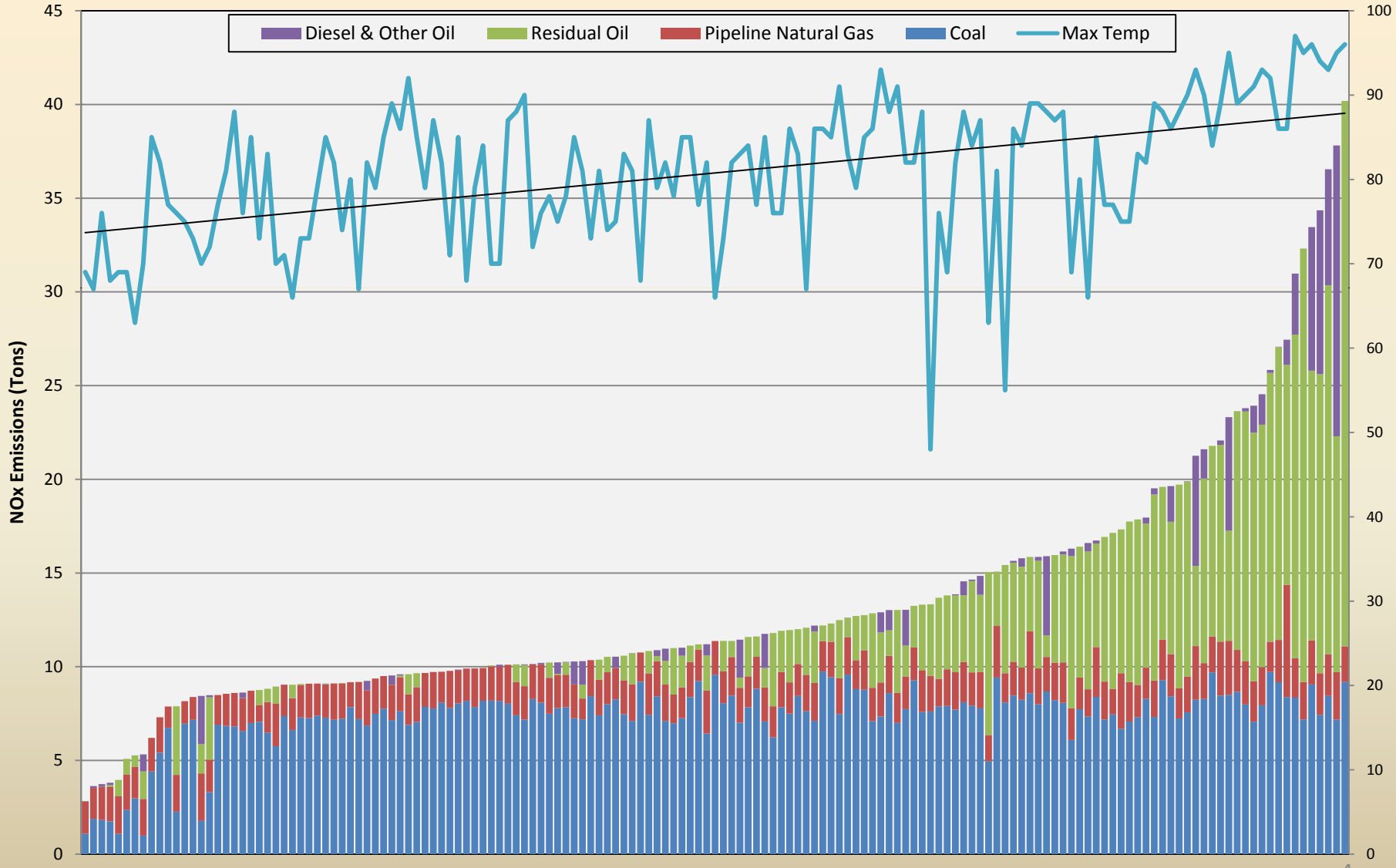
- State/regional, hourly/daily EGU NOx emissions summer of 2007 as downloaded by Robin Baena (CTDEP) from EPA's CAMD data base (for all "electricity generators", "cogenerators" and "small power producers")
- Compare SMOKE output for previous modeling with actual data
- Suggest incorporating actual hourly EGU NOx emissions into PGMs for the next round of SIPs

CT EGU Daily NOx Emissions by Primary Fuel Type
2007 Ozone Season



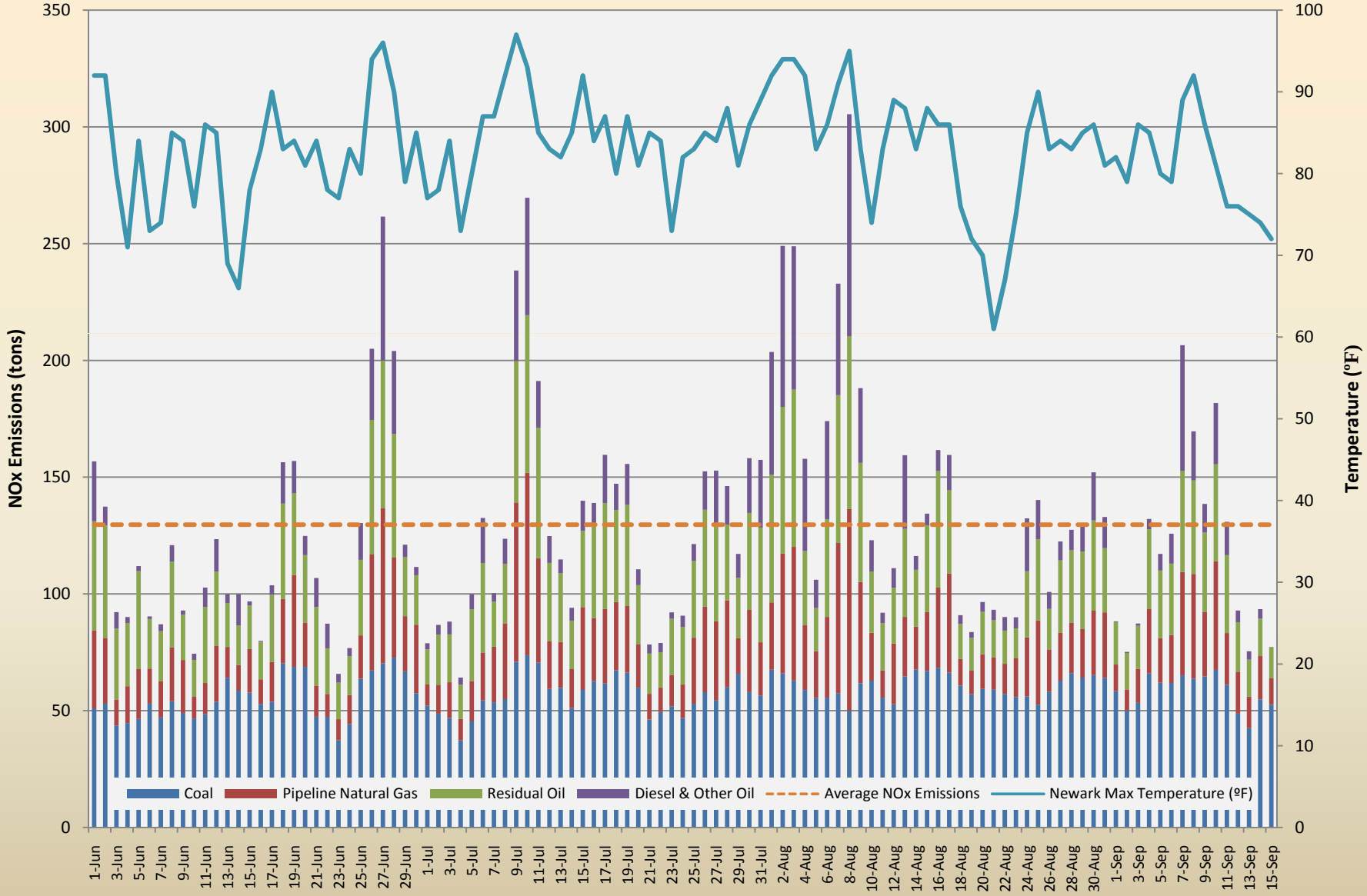
Fuel Types Comprising the Daily NOx Emissions from CT EGUs sorted by Daily NOx Emissions

2007 Ozone Season



Daily NOx Emissions for Southern NY & NJ EGUs

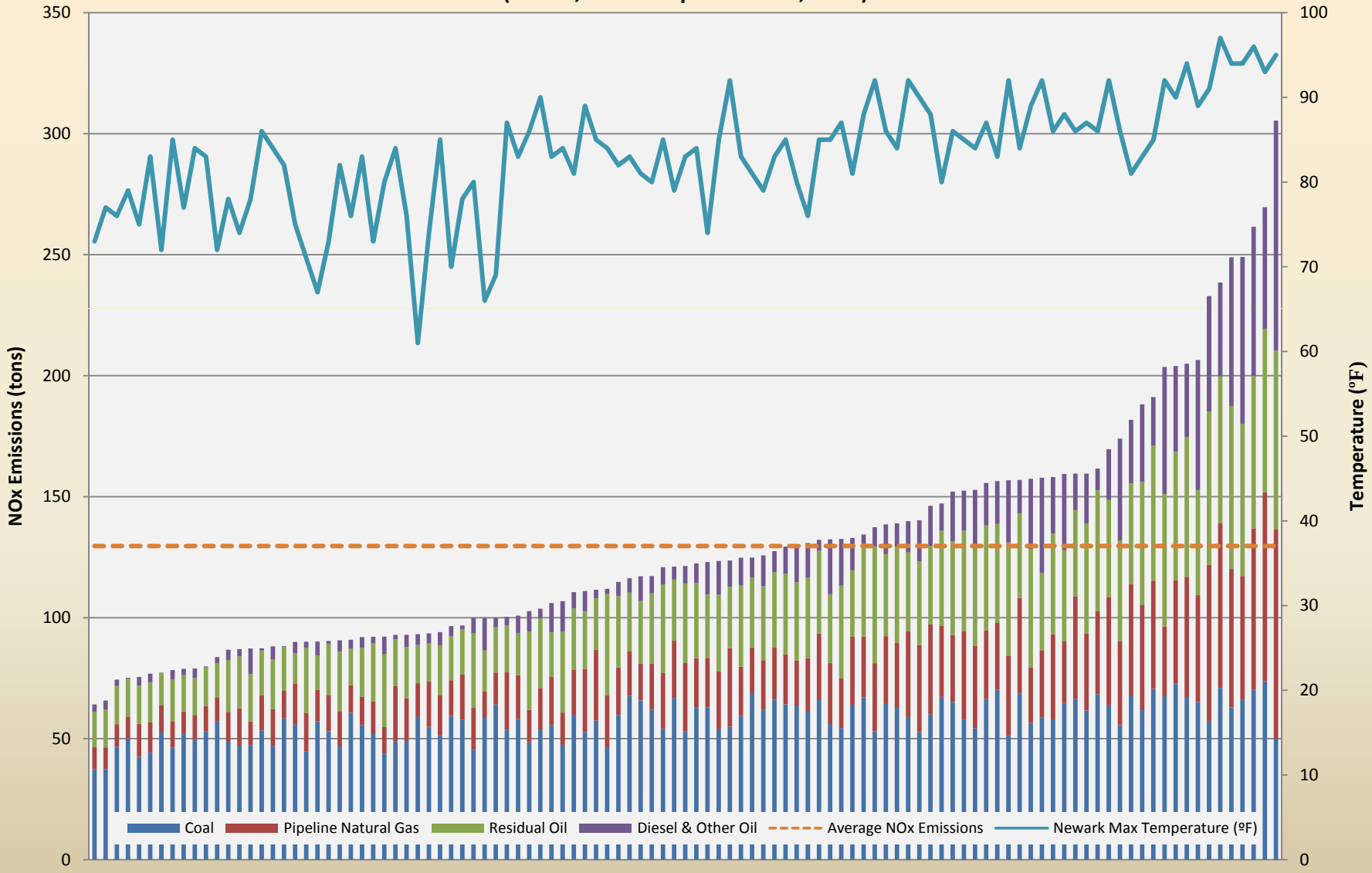
(June 1, 2007 - September 15, 2007)



Daily NOx Emissions for Southern NY & NJ EGUs

Sorted by Total Daily NOx Emitted

(June 1, 2007 - September 15, 2007)



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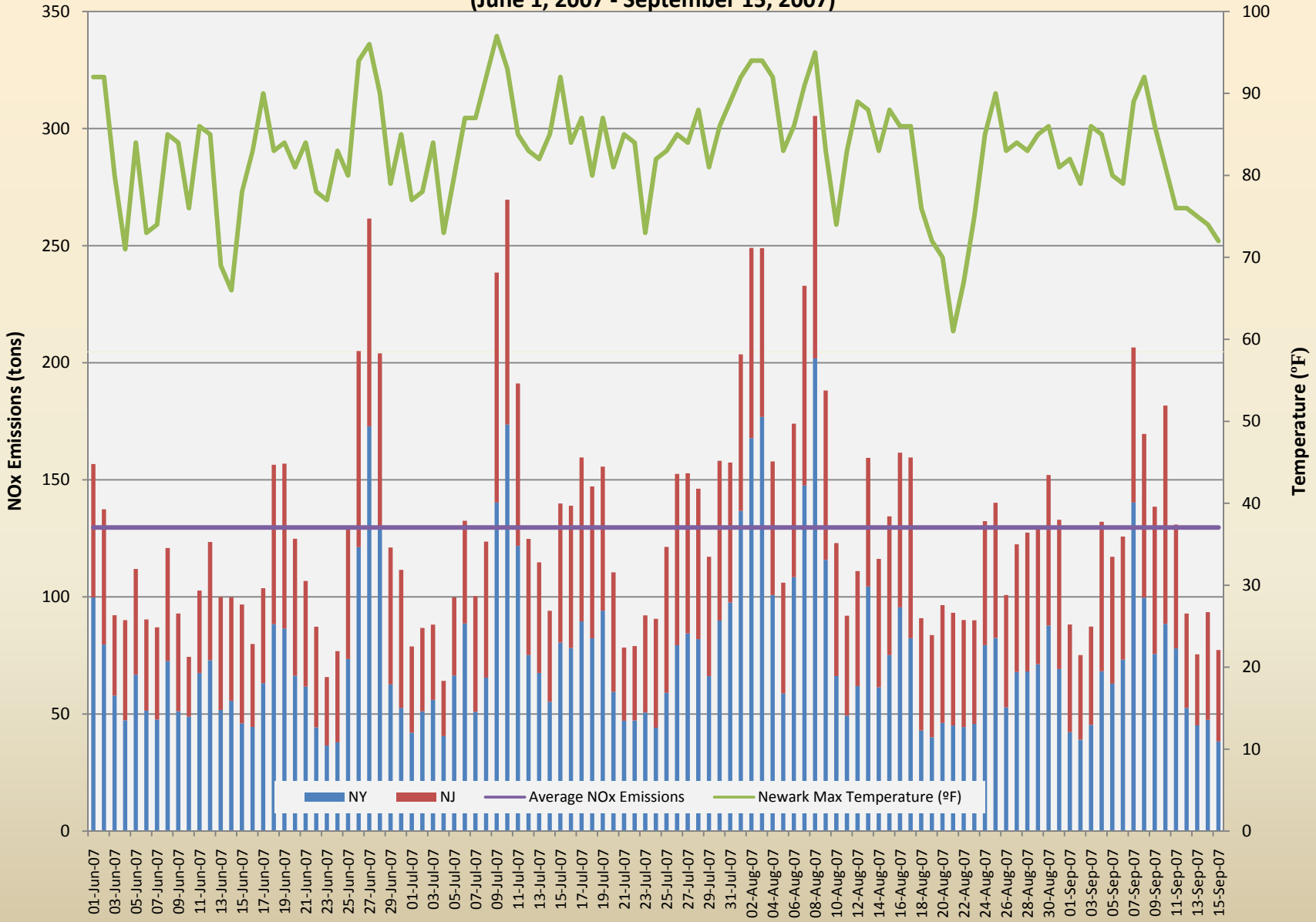
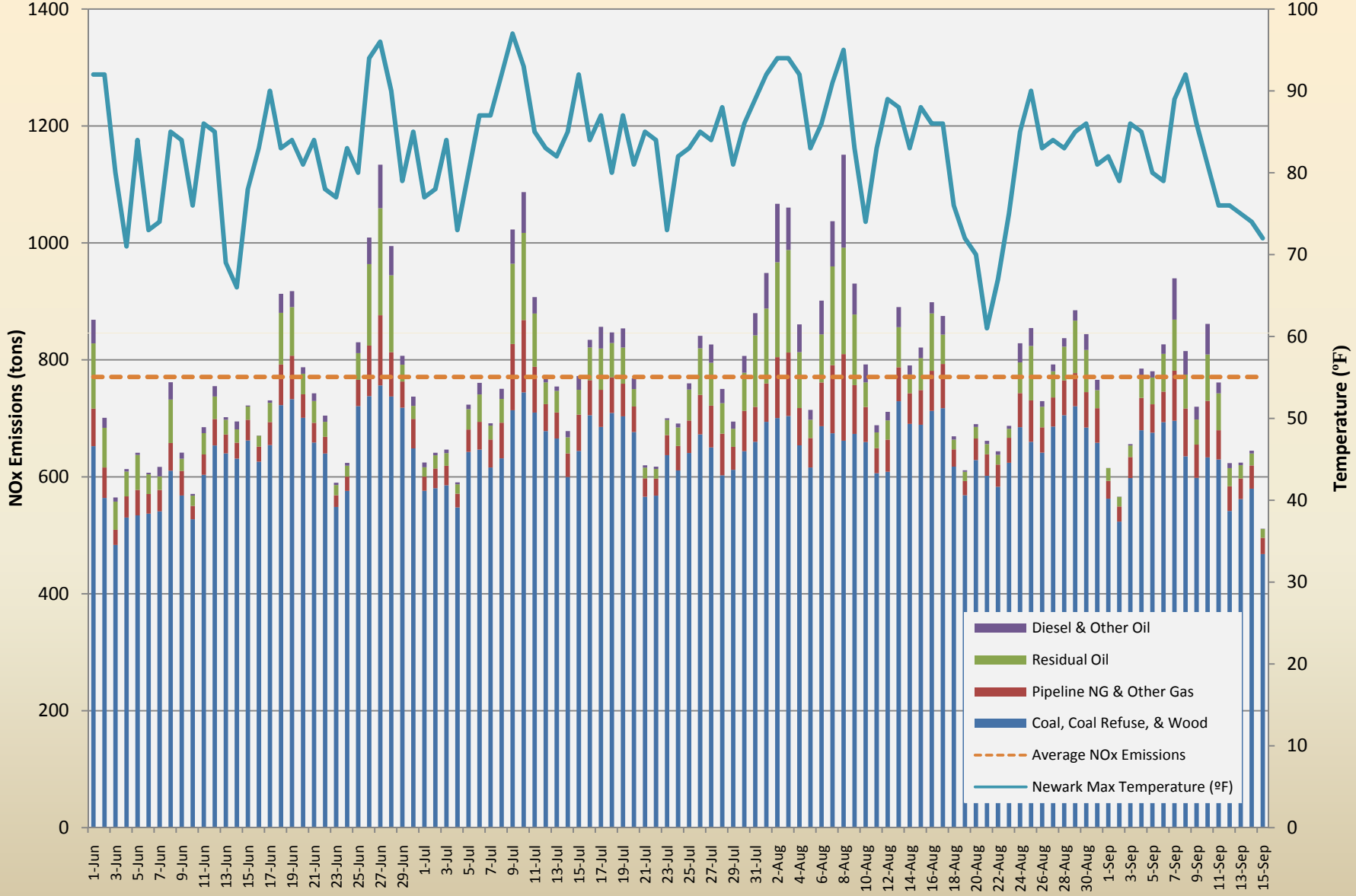


Daily NOx Emissions for EGUs in OTR (excluding VA)

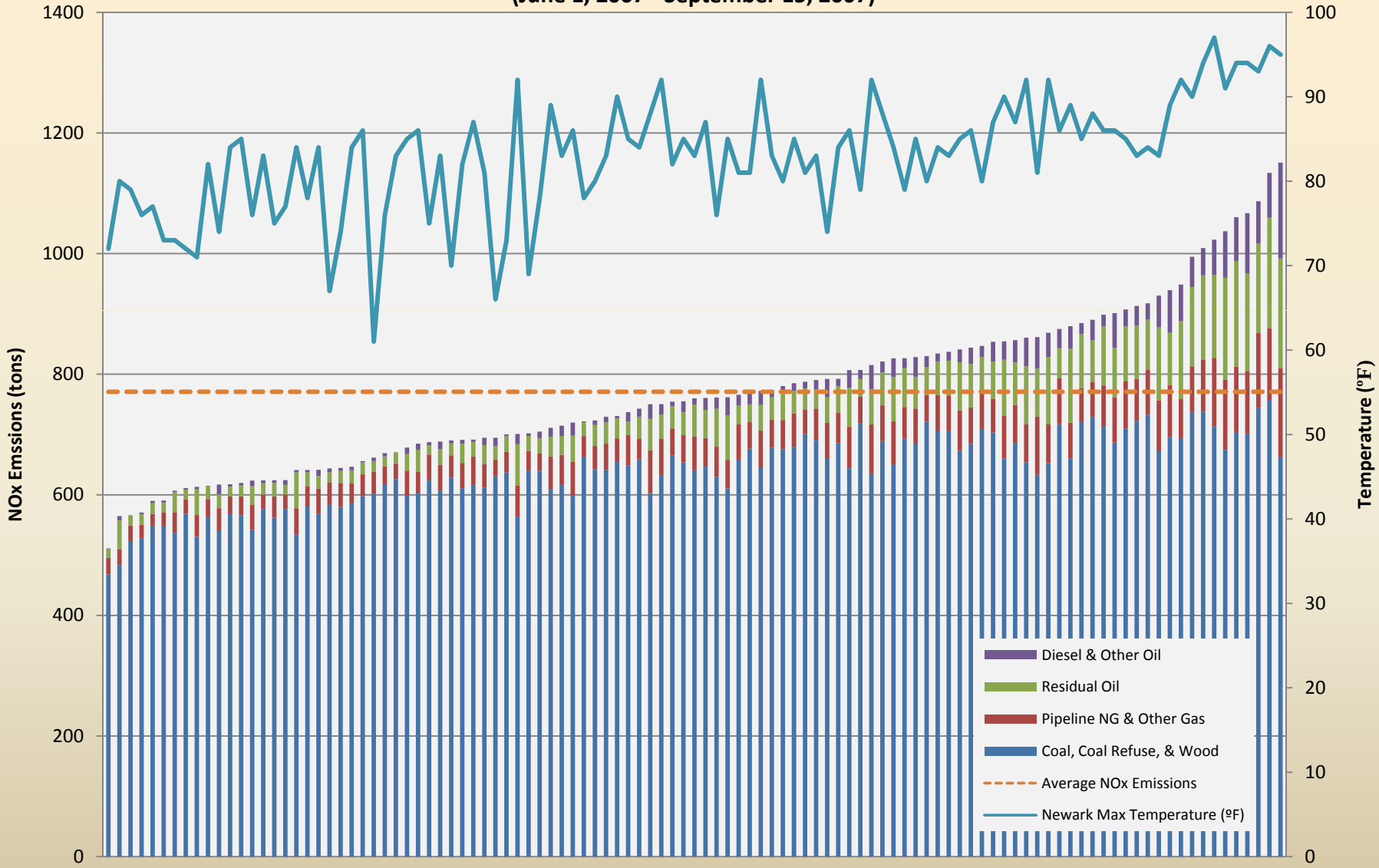
(June 1, 2007 - September 15, 2007)



Daily NOx Emissions for EGUs in OTR (excluding VA)

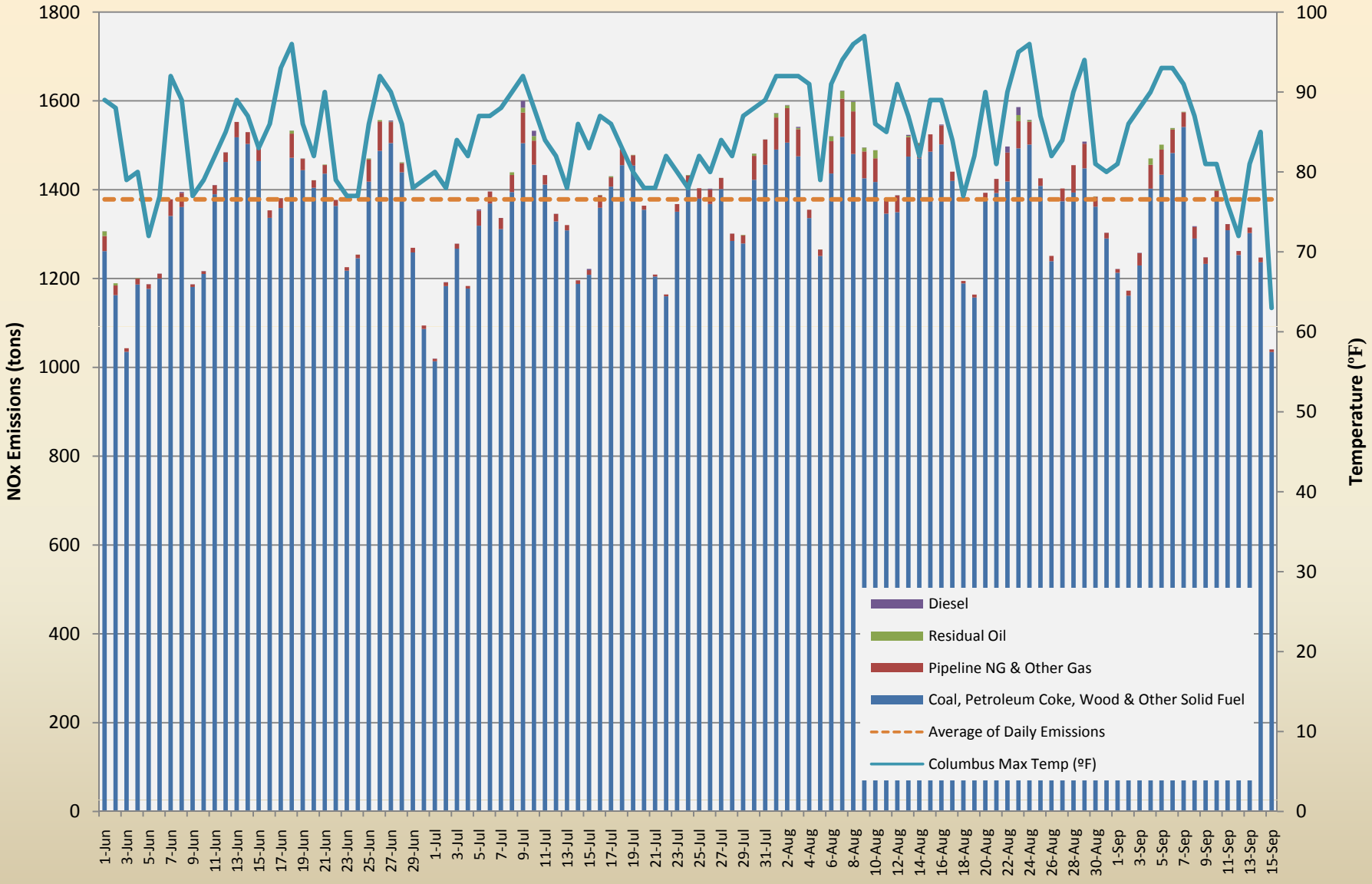
Sorted by Total Daily NOx Emitted

(June 1, 2007 - September 15, 2007)



Daily NOx Emssions from EGUs in LADCO States

(June 1, 2007 - September 15, 2007)



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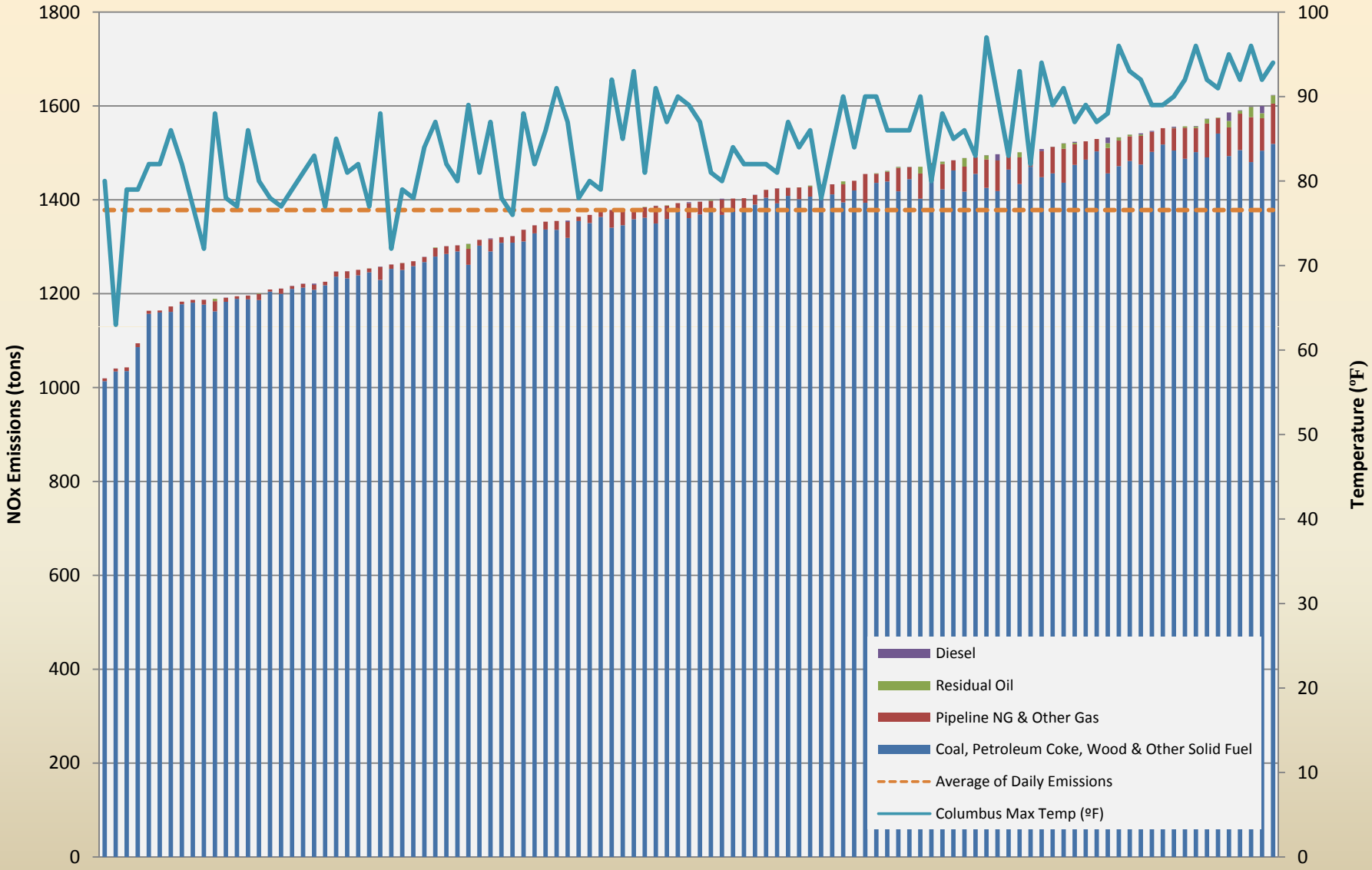
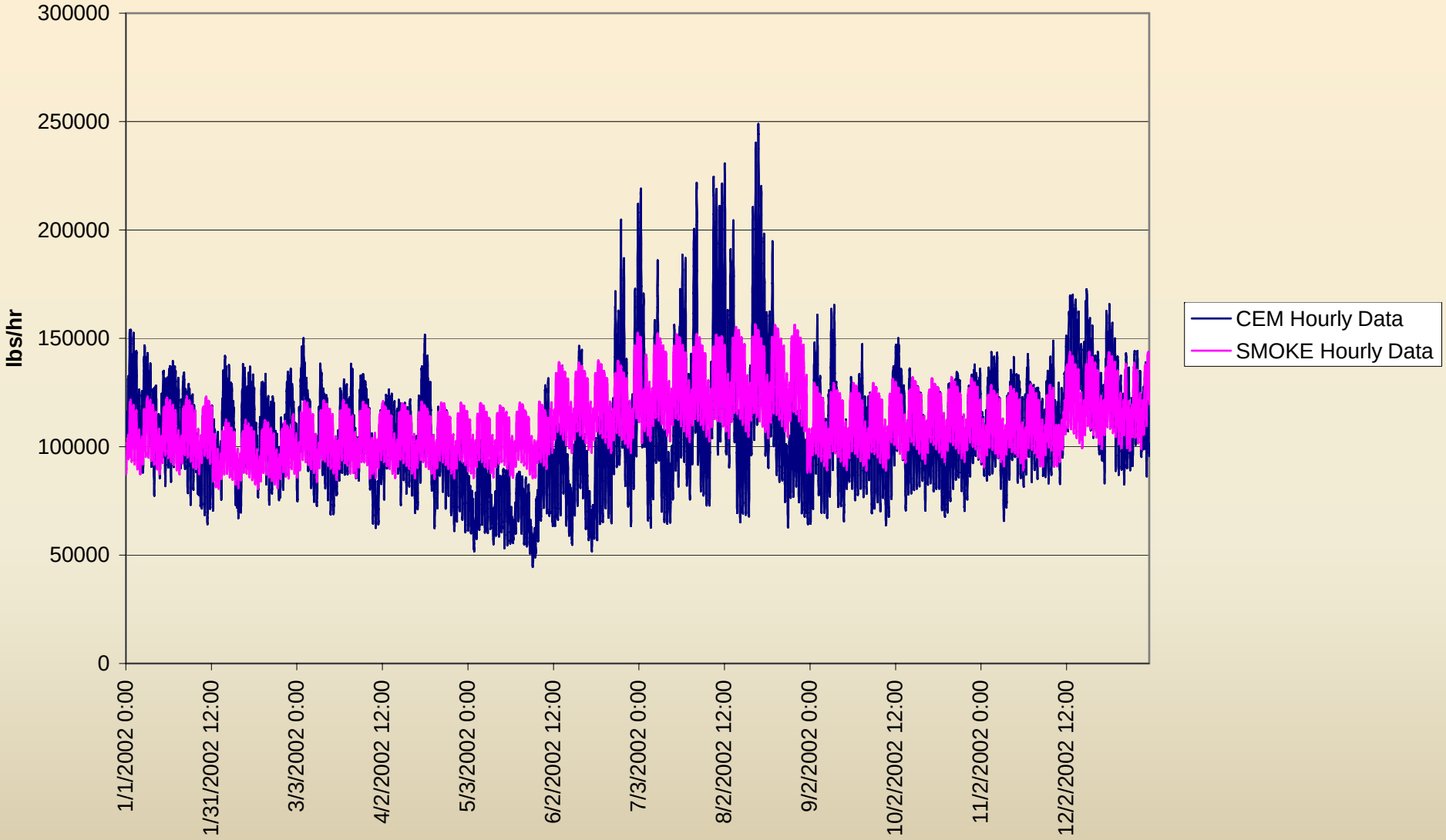


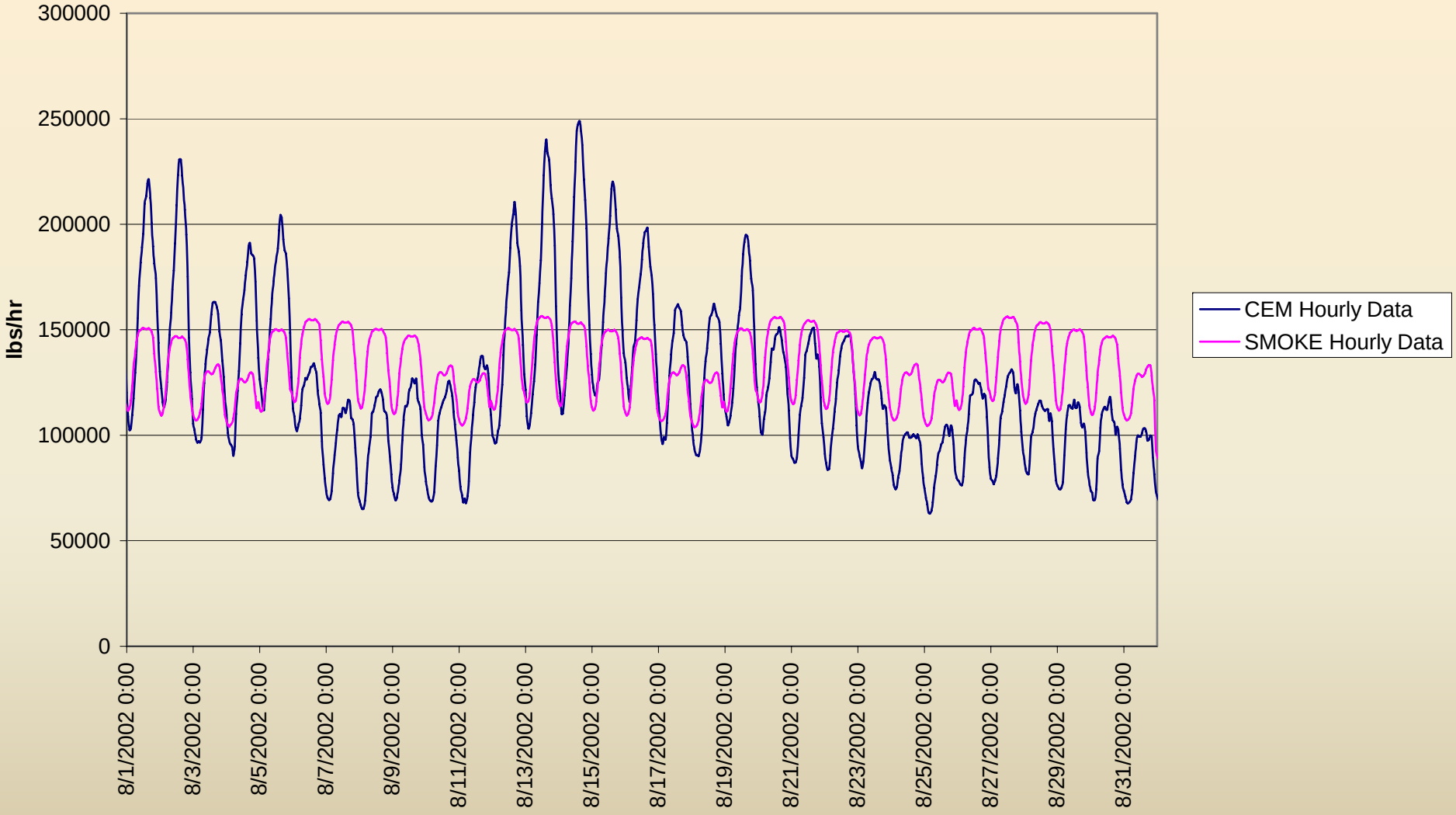
Previous SMOKE Output
vs.
Actual EGU Emissions

2002 Hourly NOx Emissions in the MANE-VU Region from CEM Data and SMOKE-Processed Point Source Files (Adjusted to Remove the Effect of non-CEM-matched Point Sources)



Provided by Gopal Sistla, NYDEC

August 2002 Hourly NOx Emissions in the MANE-VU Region from CEM Data and SMOKE-Processed Point Source Files (Adjusted to Remove the Effect of non-CEM-matched Point Sources)

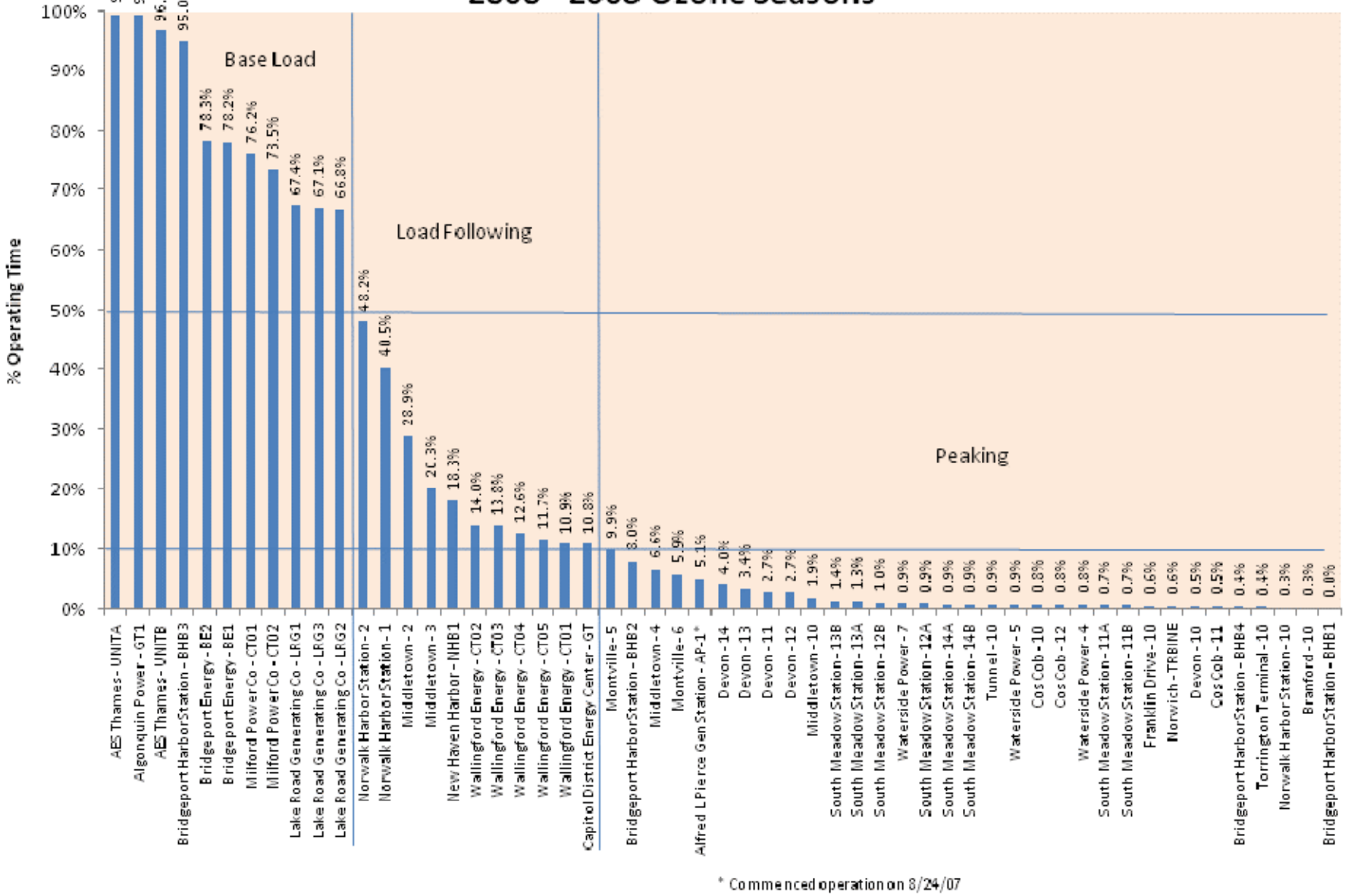


Provided by Gopal Sistla, NYDEC

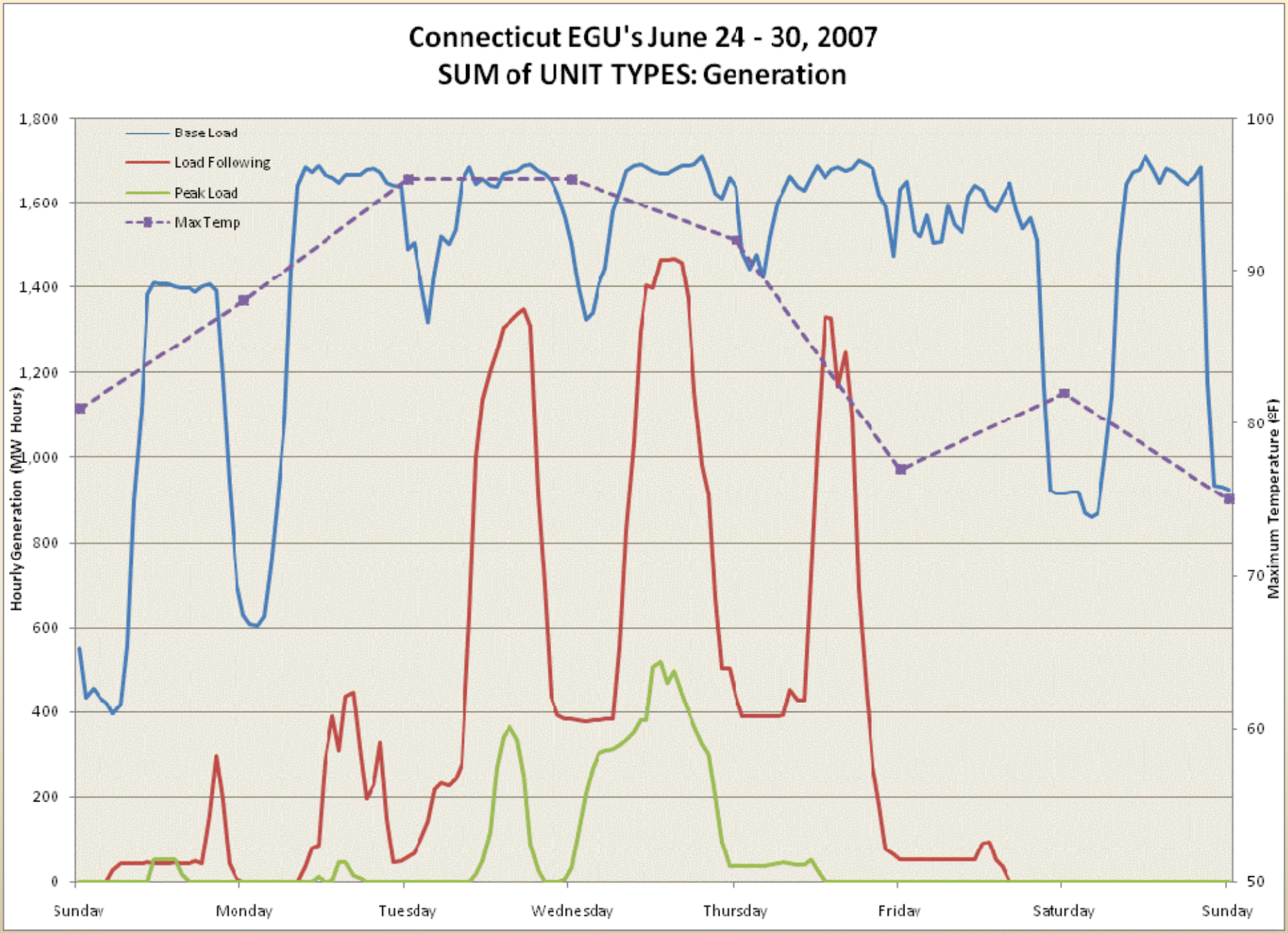
Define units by operating mode

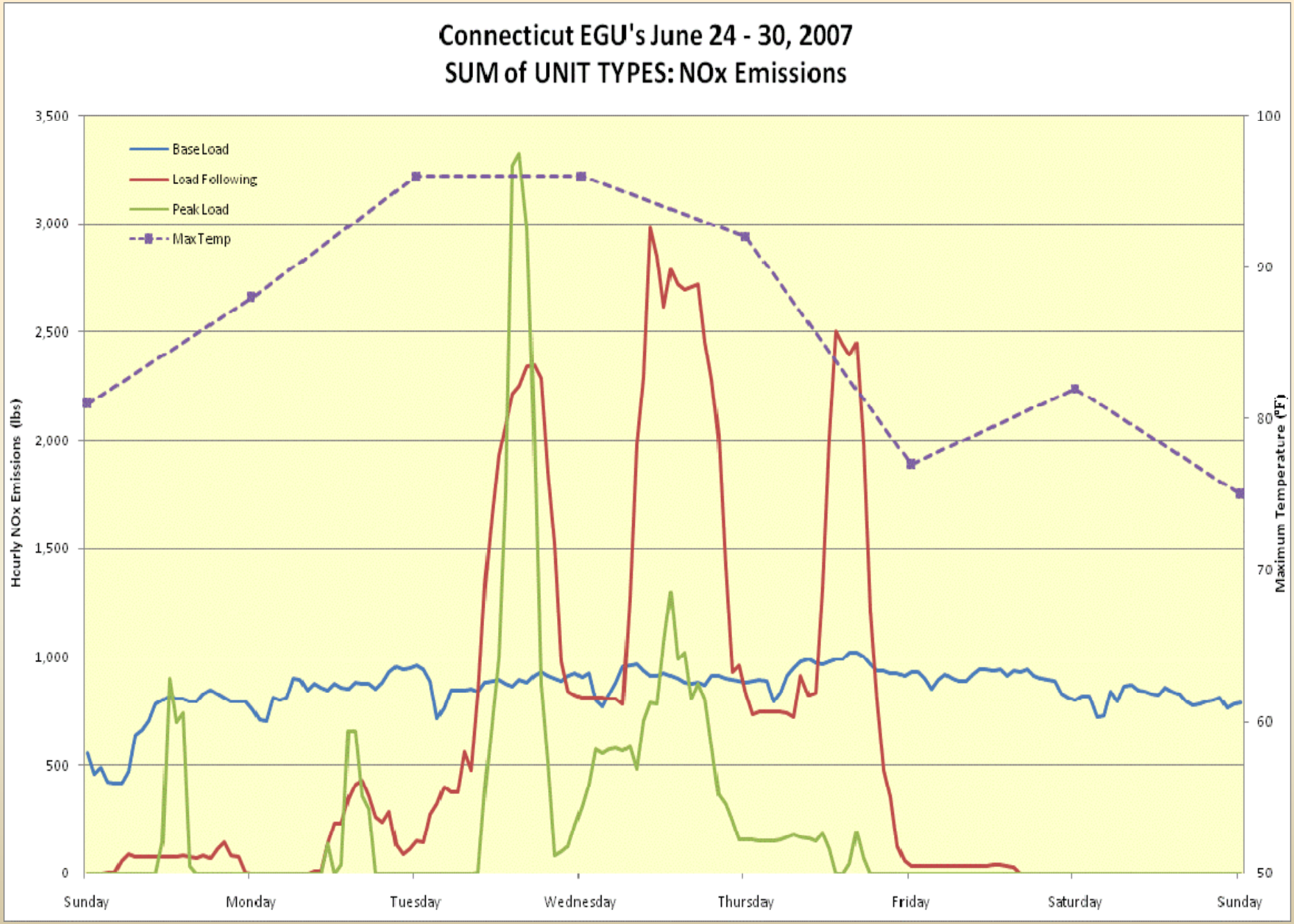
- Baseload units
- Load following units
- Peaking units

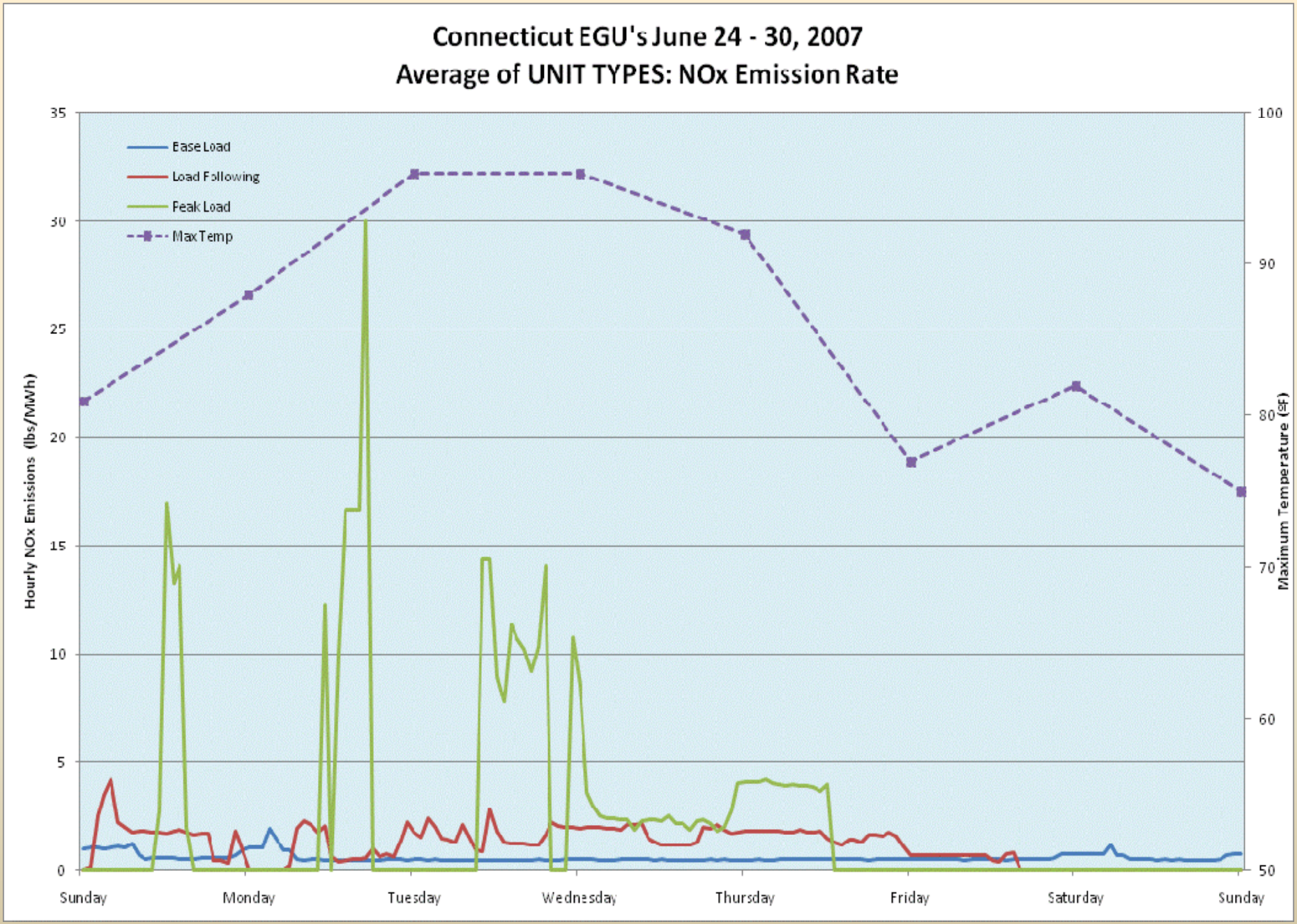
EGU Average Operating Time Percentage
2006 - 2008 Ozone Seasons



* Commenced operation on 8/24/07

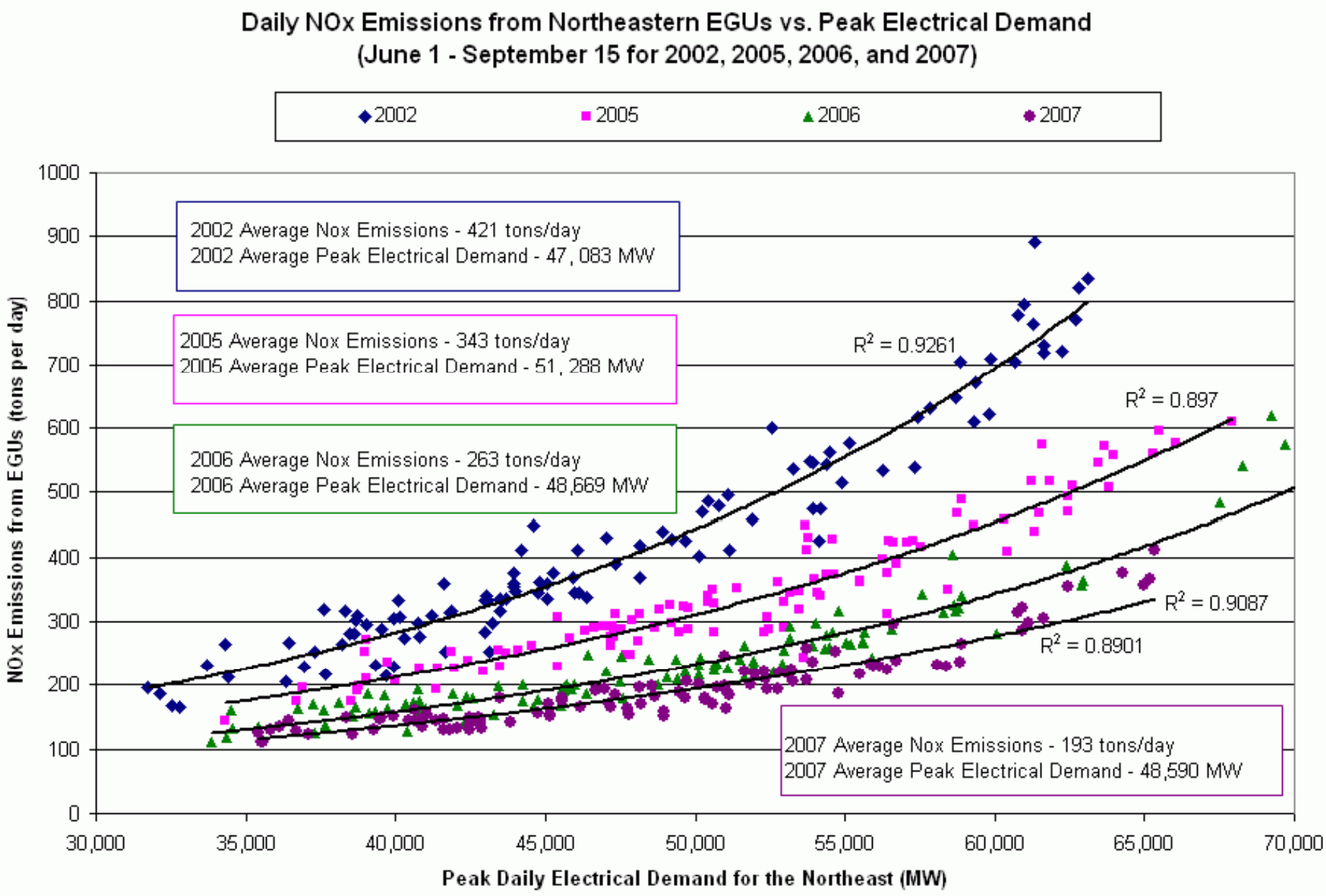

Connecticut EGU's June 24 - 30, 2007
SUM of UNIT TYPES: Generation
Base Load
Load Following
Peak Load
Max Temp
Hourly Generation (MW Hours)
Maximum Temperature (ºF)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
100
90
80
70
60
50
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


Connecticut EGU's June 24 - 30, 2007
SUM of UNIT TYPES: NOx Emissions
Base Load
Load Following
Peak Load
Max Temp
Hourly NOx Emissions (lbs)
Maximum Temperature (°F)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
100
90
80
70
60
50
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

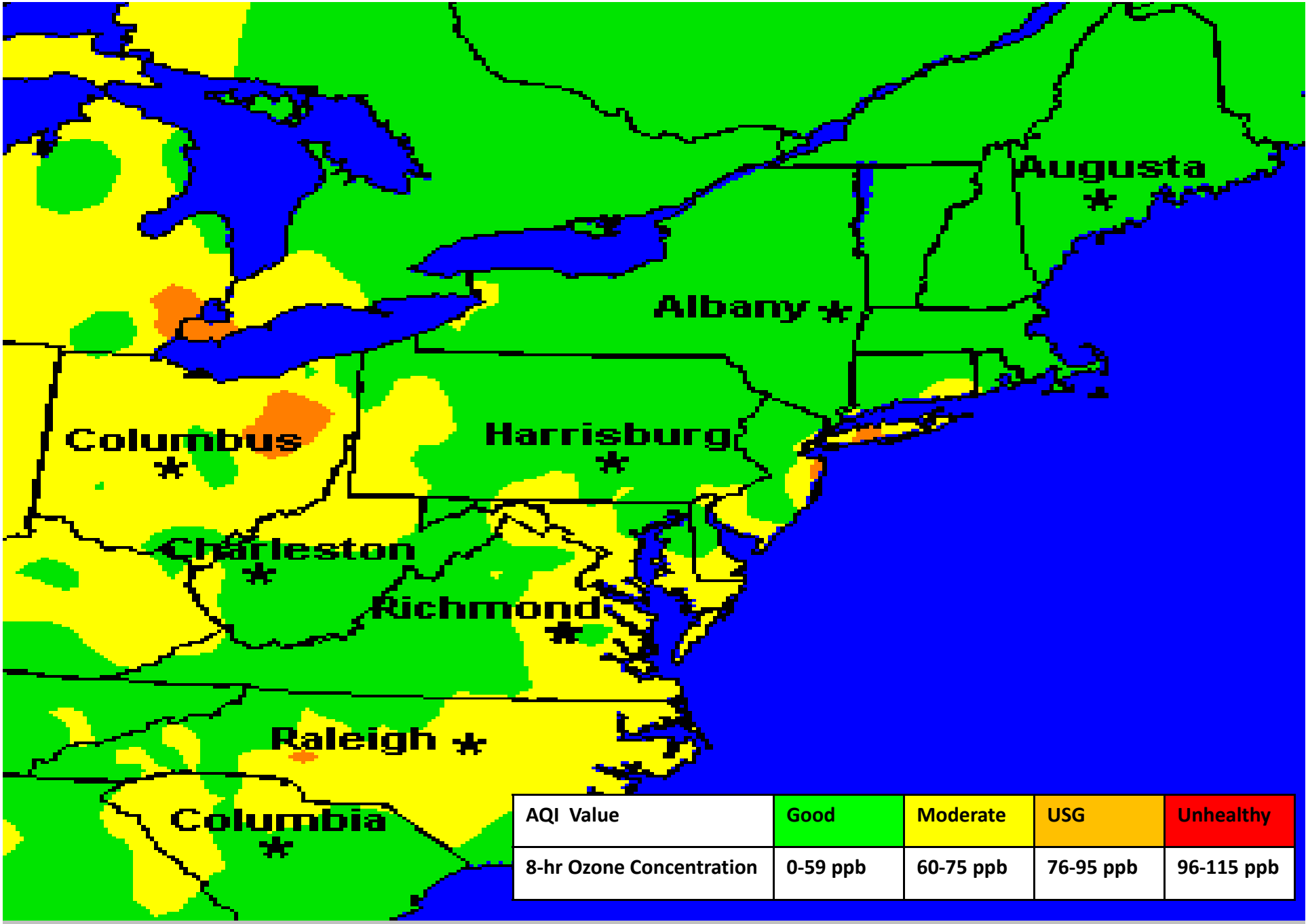

Connecticut EGU's June 24 - 30, 2007
Average of UNIT TYPES: NOx Emission Rate
Base Load
Load Following
Peak Load
Max Temp
Hourly NOx Emissions (lbs/MWh)
Maximum Temperature (ºF)
35
30
25
20
15
10
5
0
100
90
80
70
60
50
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

Historical Perspective in the NE

2002-2007

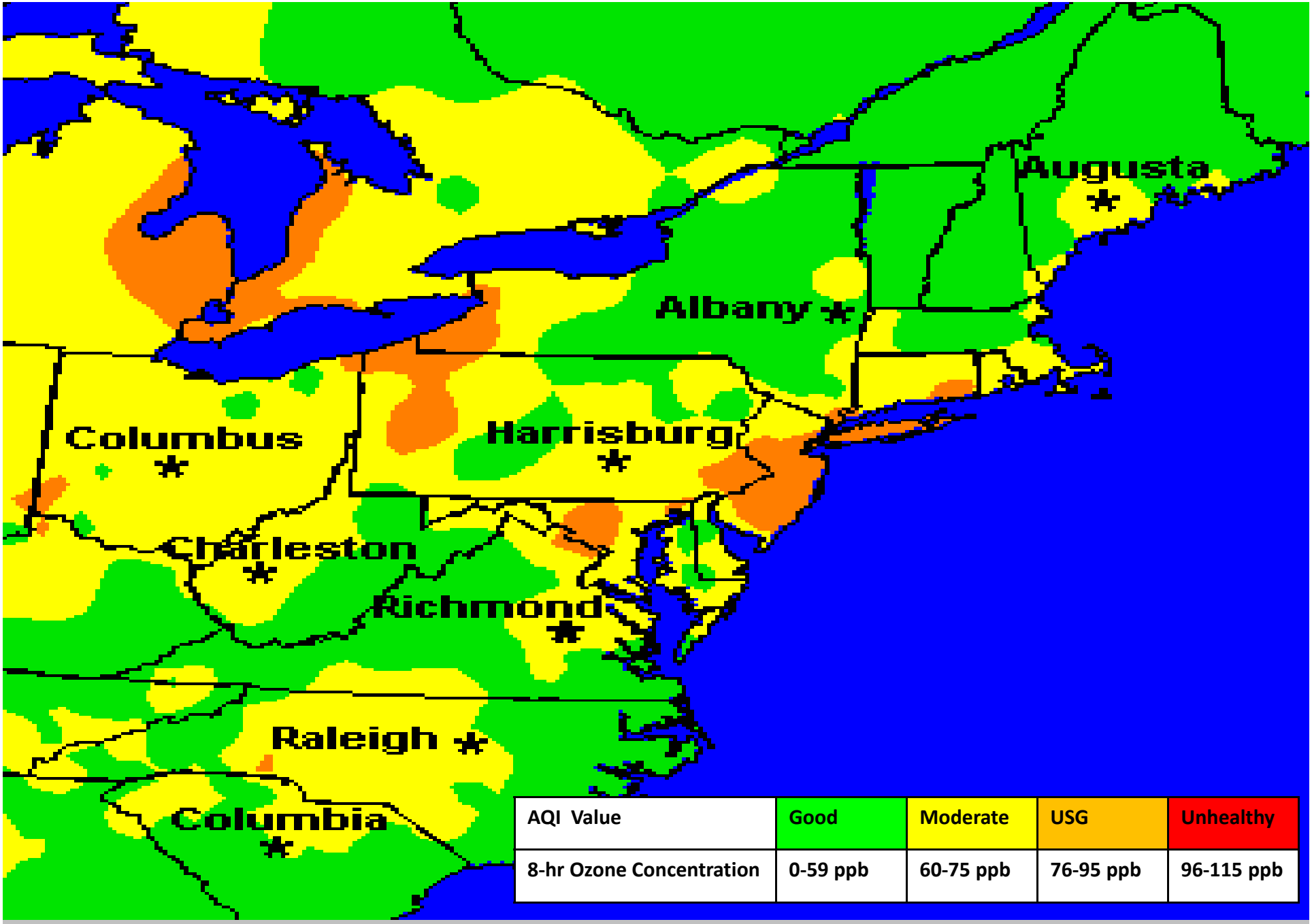

Daily NOx Emissions from Northeastern EGUs vs. Peak Electrical Demand
(June 1 - September 15 for 2002, 2005, 2006, and 2007)
2002
2005
2006
2007
2002 Average Nox Emissions - 421 tons/day
2002 Average Peak Electrical Demand - 47, 083 MW
2005 Average Nox Emissions - 343 tons/day
2005 Average Peak Electrical Demand - 51, 288 MW
2006 Average Nox Emissions - 263 tons/day
2006 Average Peak Electrical Demand - 48,669 MW
2007 Average Nox Emissions - 193 tons/day
2007 Average Peak Electrical Demand - 48,590 MW
R2 = 0.9261
R2 = 0.897
R2 = 0.9087
R2 = 0.8901
NOx Emissions from EGUs (tons per day)
Peak Daily Electrical Demand for the Northeast (MW)
0
100
200
300
400
500
600
700
800
900
1000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000

Potential 2007Episode for Base Year Modeling



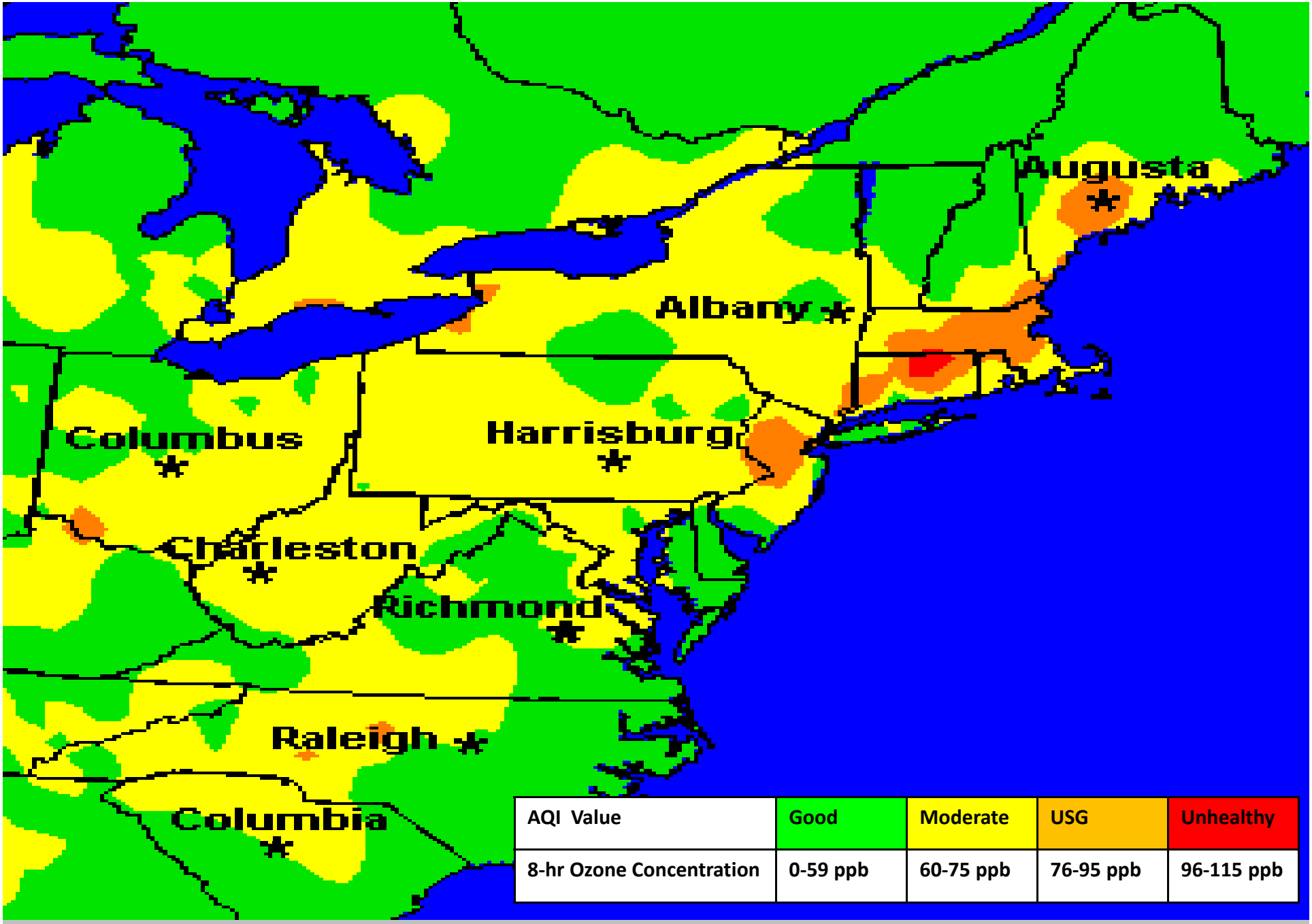
AQI Value	Good	Moderate	USG	Unhealthy
8-hr Ozone Concentration	0-59 ppb	60-75 ppb	76-95 ppb	96-115 ppb

August 1, 2007



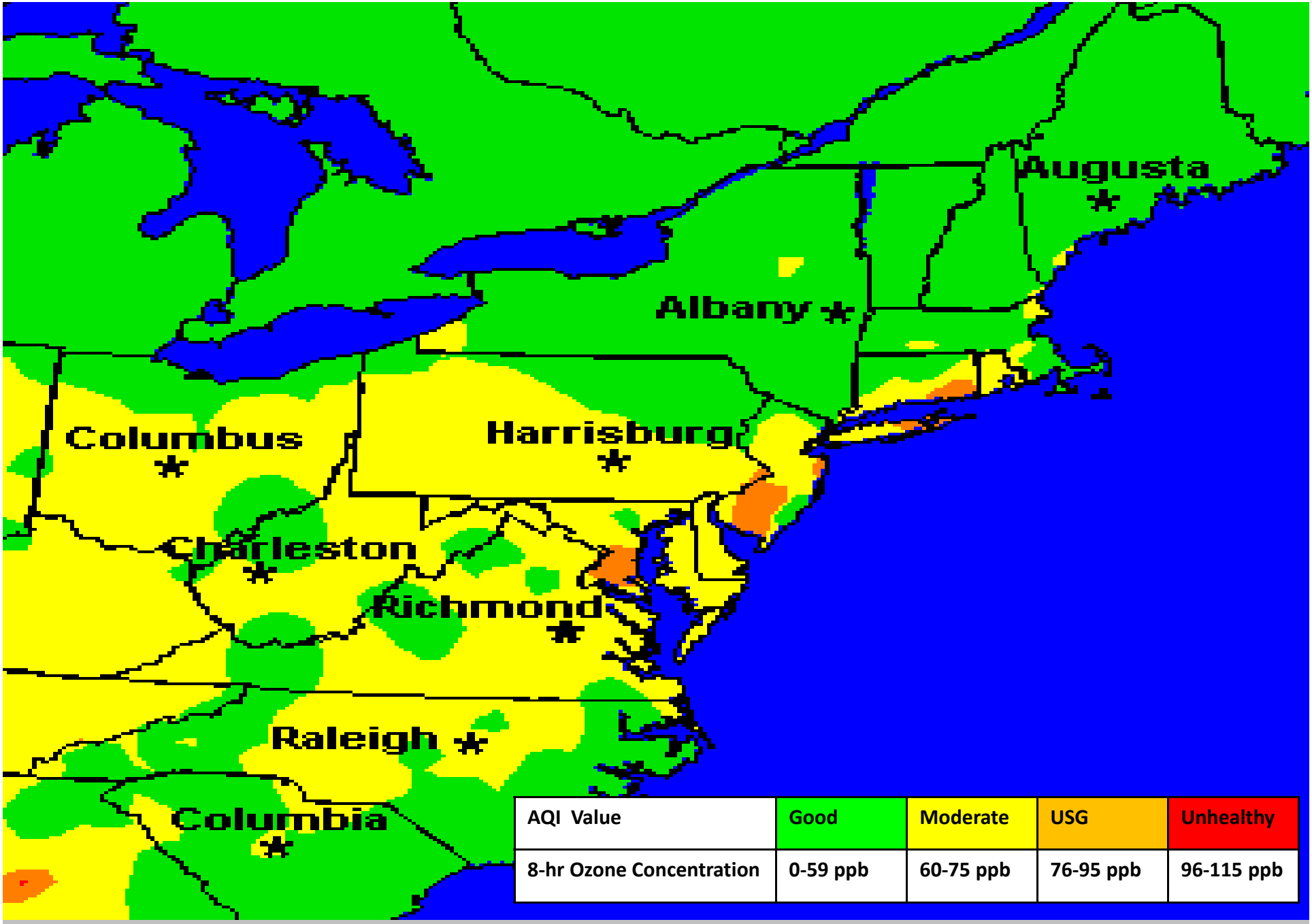
AQI Value	Good	Moderate	USG	Unhealthy
8-hr Ozone Concentration	0-59 ppb	60-75 ppb	76-95 ppb	96-115 ppb

August 2, 2007



AQI Value	Good	Moderate	USG	Unhealthy
8-hr Ozone Concentration	0-59 ppb	60-75 ppb	76-95 ppb	96-115 ppb

August 3, 2007



AQI Value	Good	Moderate	USG	Unhealthy
8-hr Ozone Concentration	0-59 ppb	60-75 ppb	76-95 ppb	96-115 ppb

August 4, 2007

Future Year Modeling

OTC HEDD Modeling Effort

- HEDD Workgroup formed March 2009
- Charge:
  - Determine, from a regional modeling perspective, what information is needed to accurately model EGU emissions on HEDDs, and
  - Isolate and apply emission adjustments specific to the sector

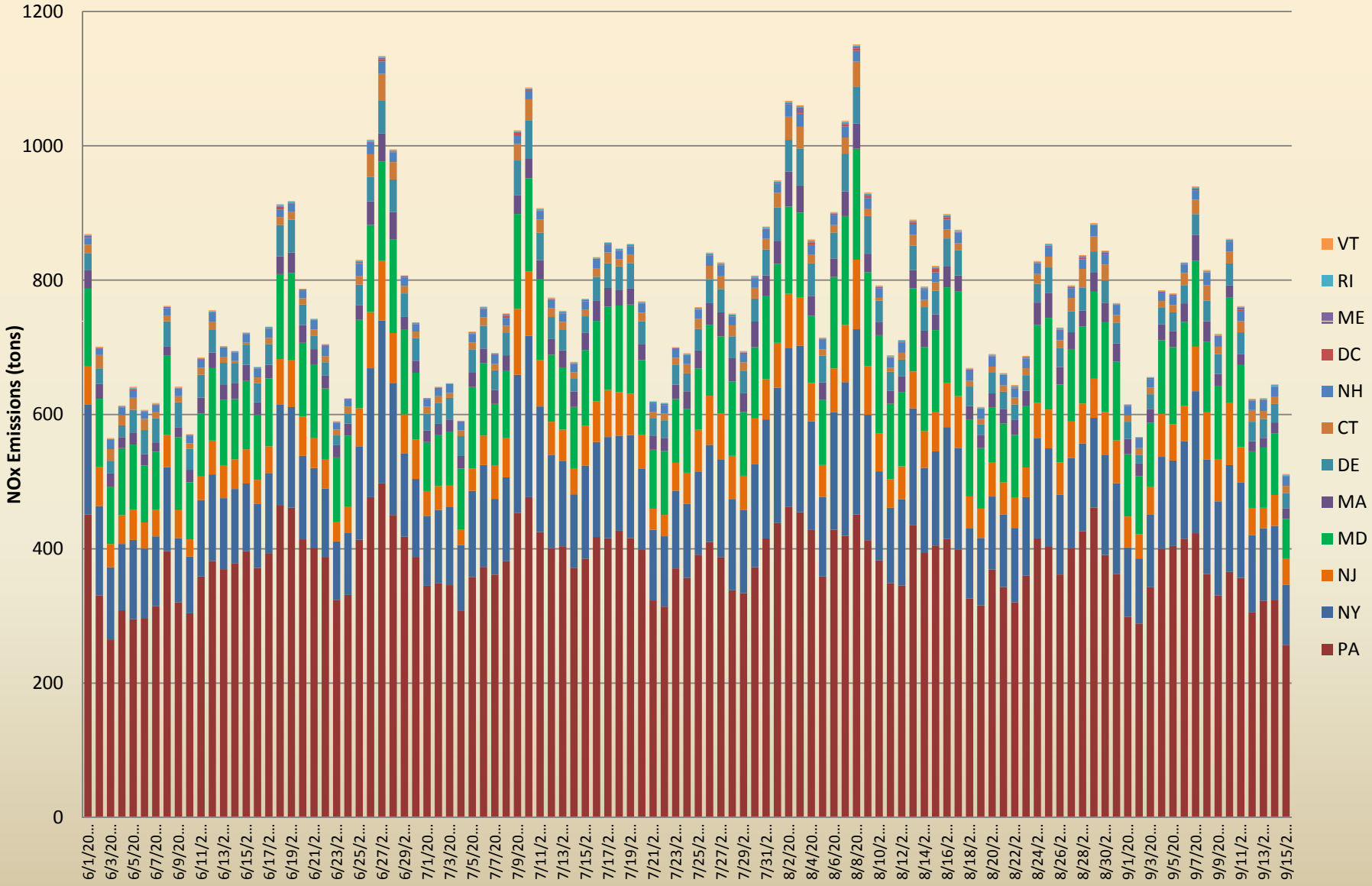
Issue: EGU Growth Estimates

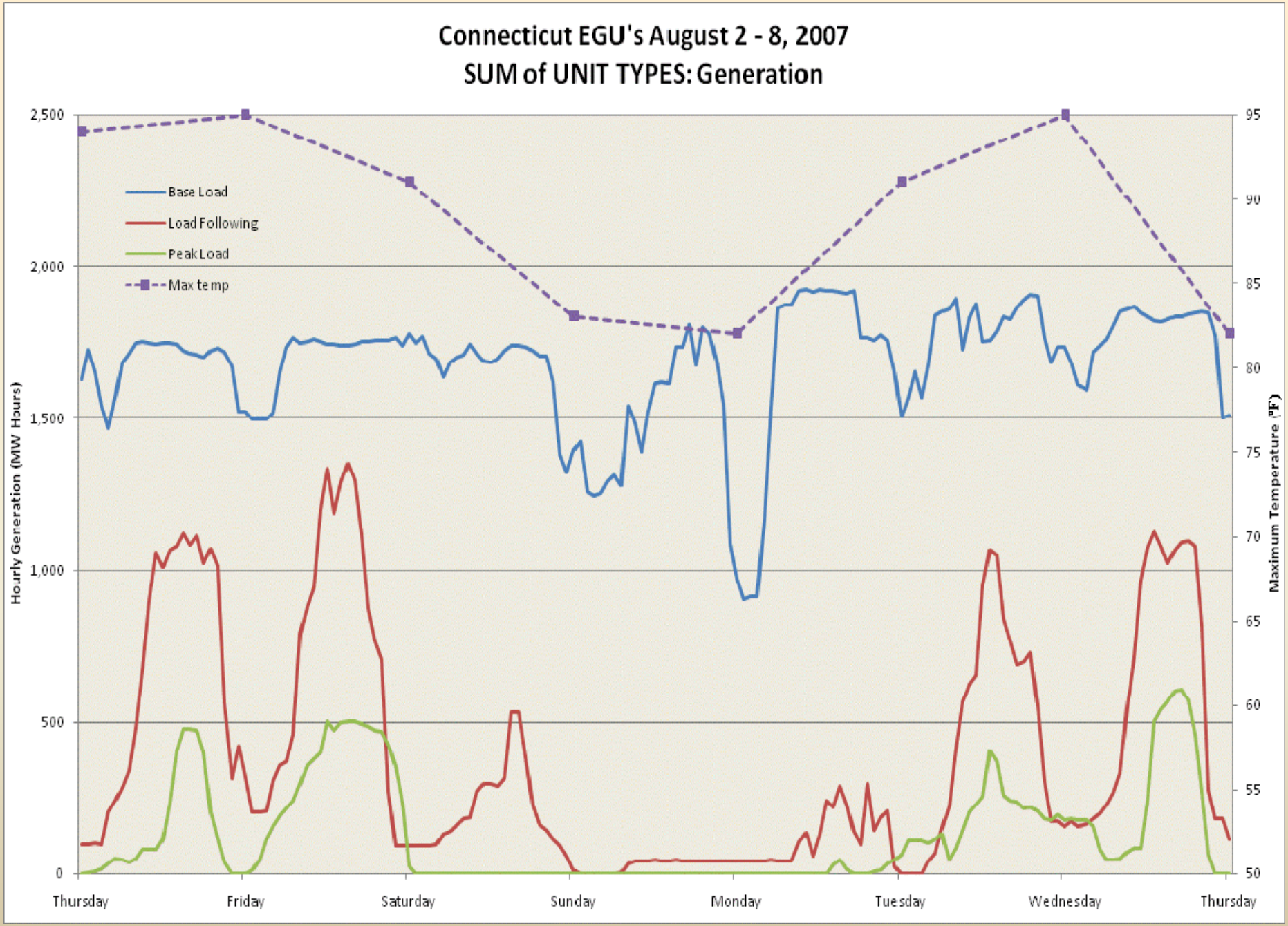
- IPM (Integrated Planning Model)
  - Proprietary
  - Expensive
  - Not designed for day-specific variability
- EIA Growth Estimates
  - Could be applied to hourly base year emissions across the board or
  - Based on fuel and source type
- More discussion needed

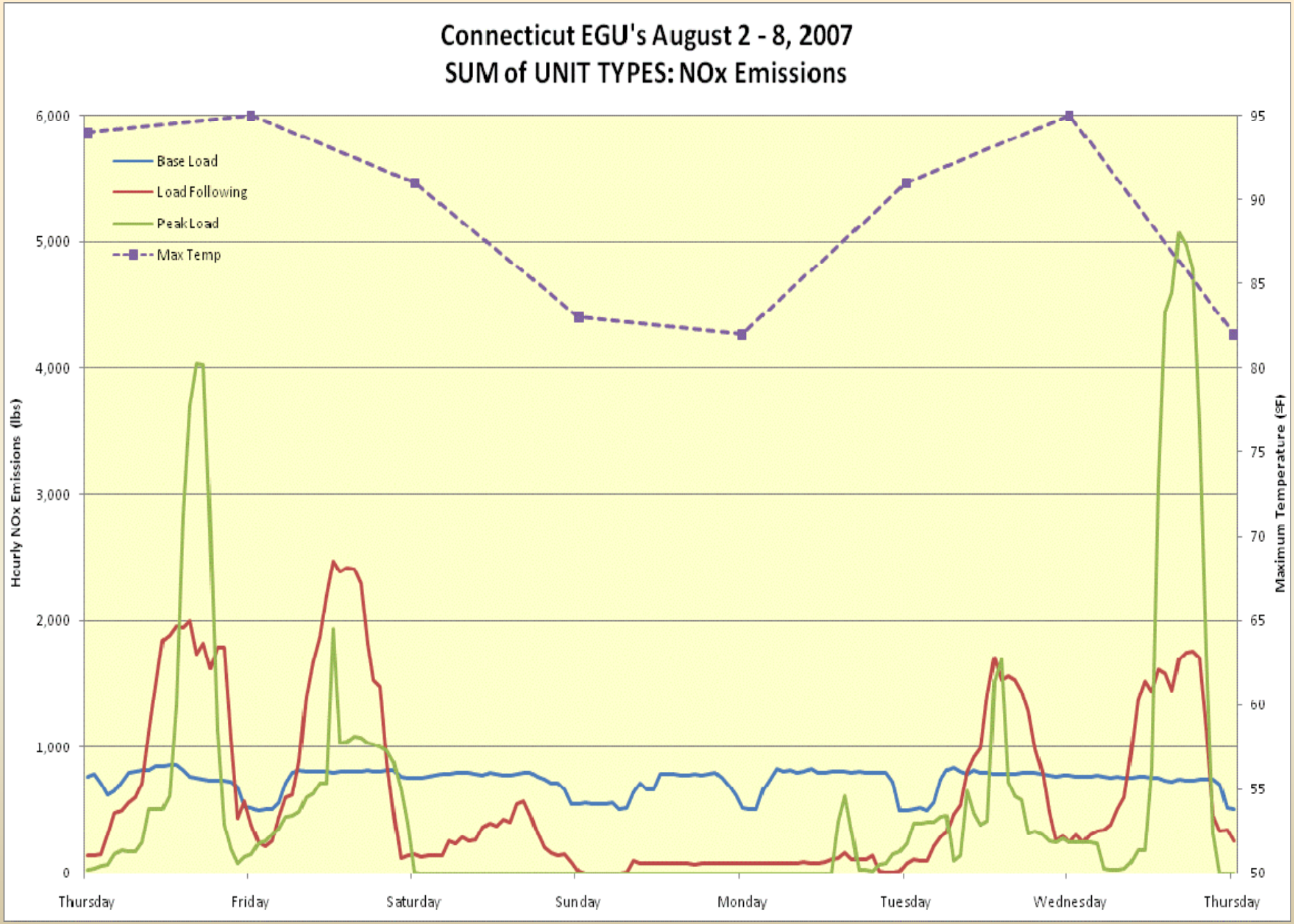
Extra Slides

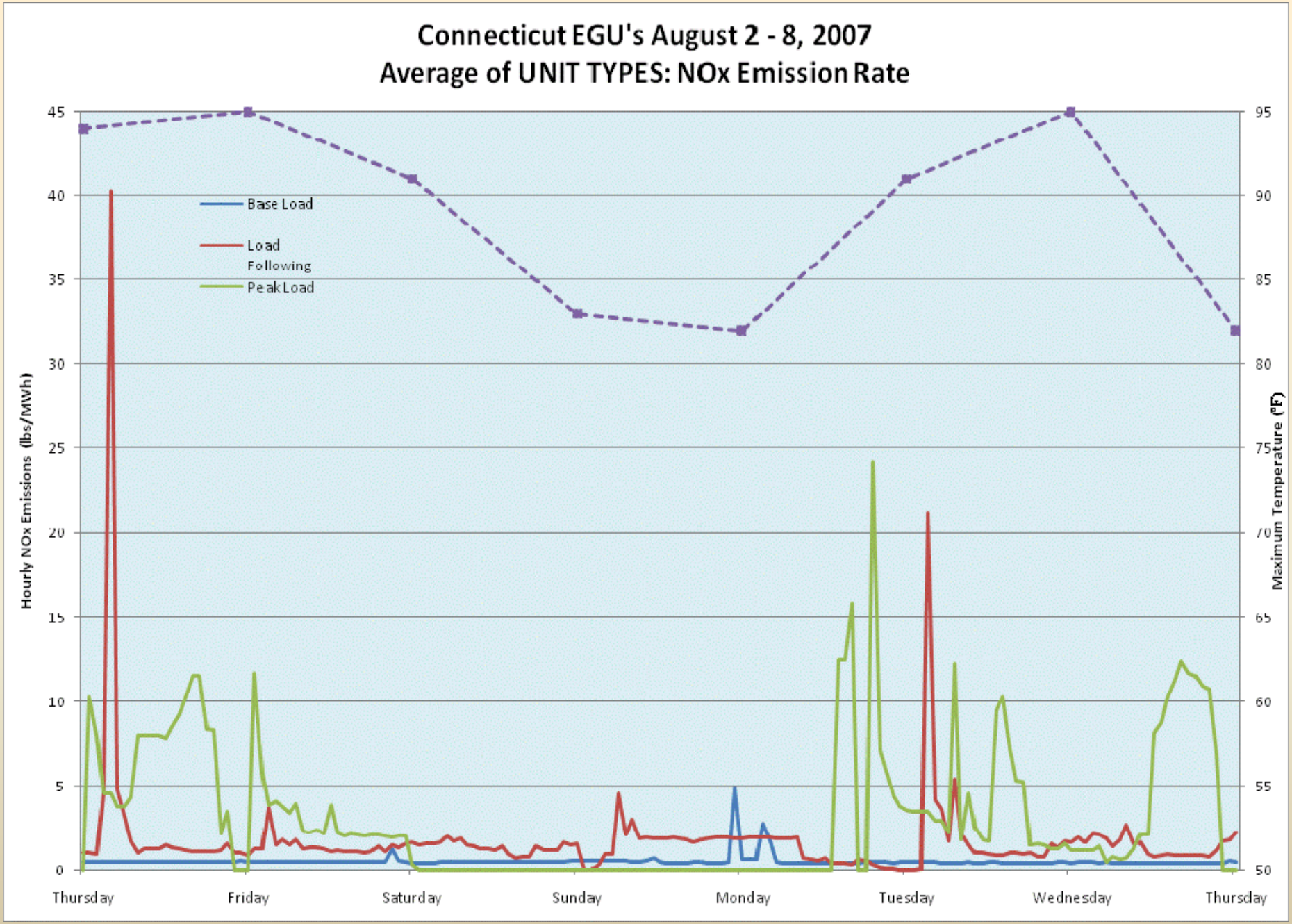
Daily NOx Emissions for EGUs in OTR (excluding VA)

(June 1, 2007 - September 15, 2007)




Connecticut EGU's August 2 - 8, 2007
SUM of UNIT TYPES: Generation
Base Load
Load Following
Peak Load
Max temp
Hourly Generation (MW Hours)
Maximum Temperature (°F)
2,500
2,000
1,500
1,000
500
0
95
90
85
80
75
70
65
60
55
50
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Thursday


Connecticut EGU's August 2 - 8, 2007
SUM of UNIT TYPES: NOx Emissions
Base Load
Load Following
Peak Load
Max Temp
Hourly NOx Emissions (lbs)
Maximum Temperature (ºF)
6,000
5,000
4,000
3,000
2,000
1,000
0
95
90
85
80
75
70
65
60
55
50
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Thursday


Connecticut EGU's August 2 - 8, 2007
Average of UNIT TYPES: NOx Emission Rate
Base Load
Load Following
Peak Load
Hourly NOx Emissions (lbs/MWh)
Maximum Temperature (°F)
45
40
35
30
25
20
15
10
5
0
95
90
85
80
75
70
65
60
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Thursday
Friday
Saturday
Sunday
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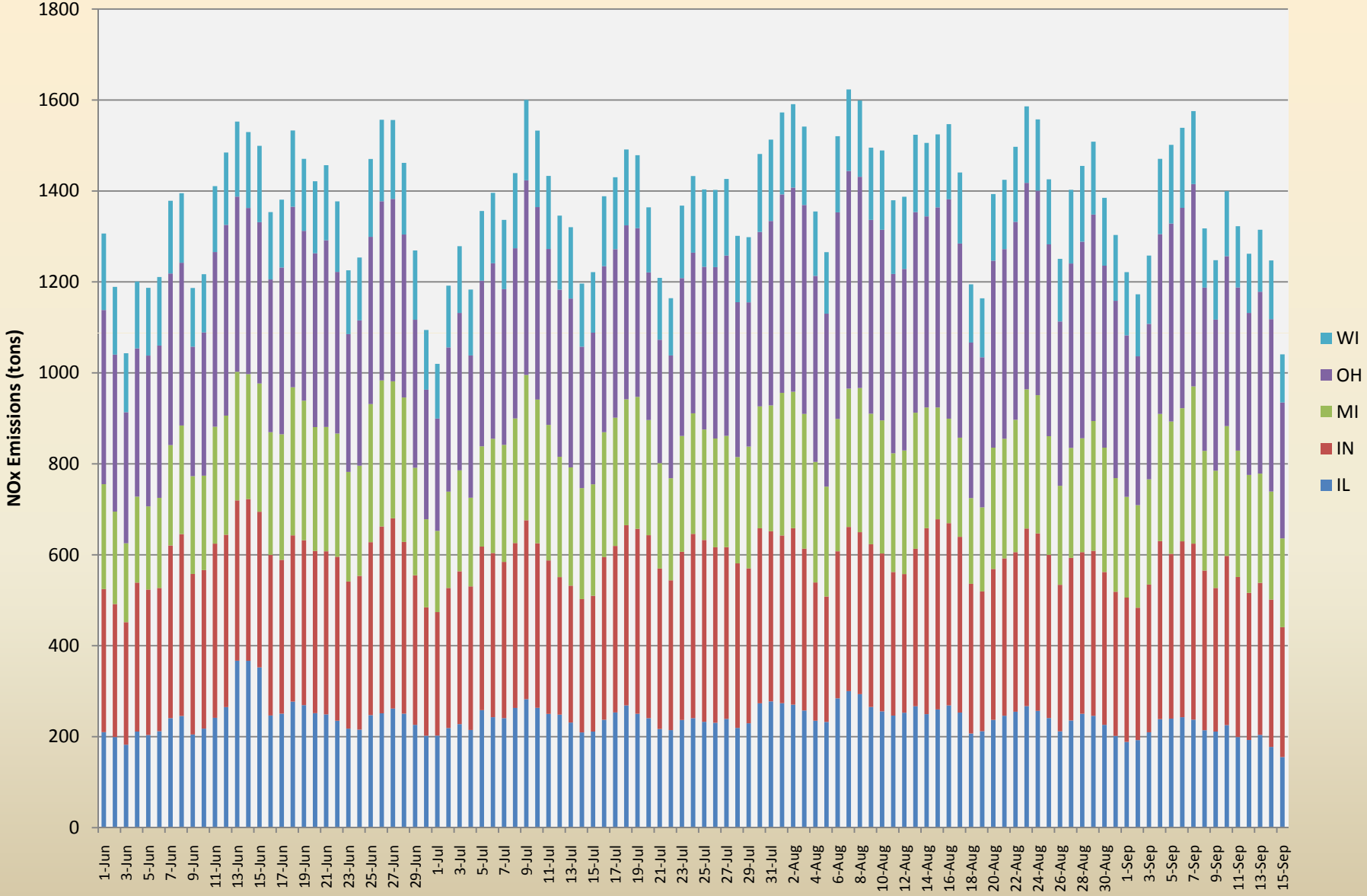
Wednesday
Thursday

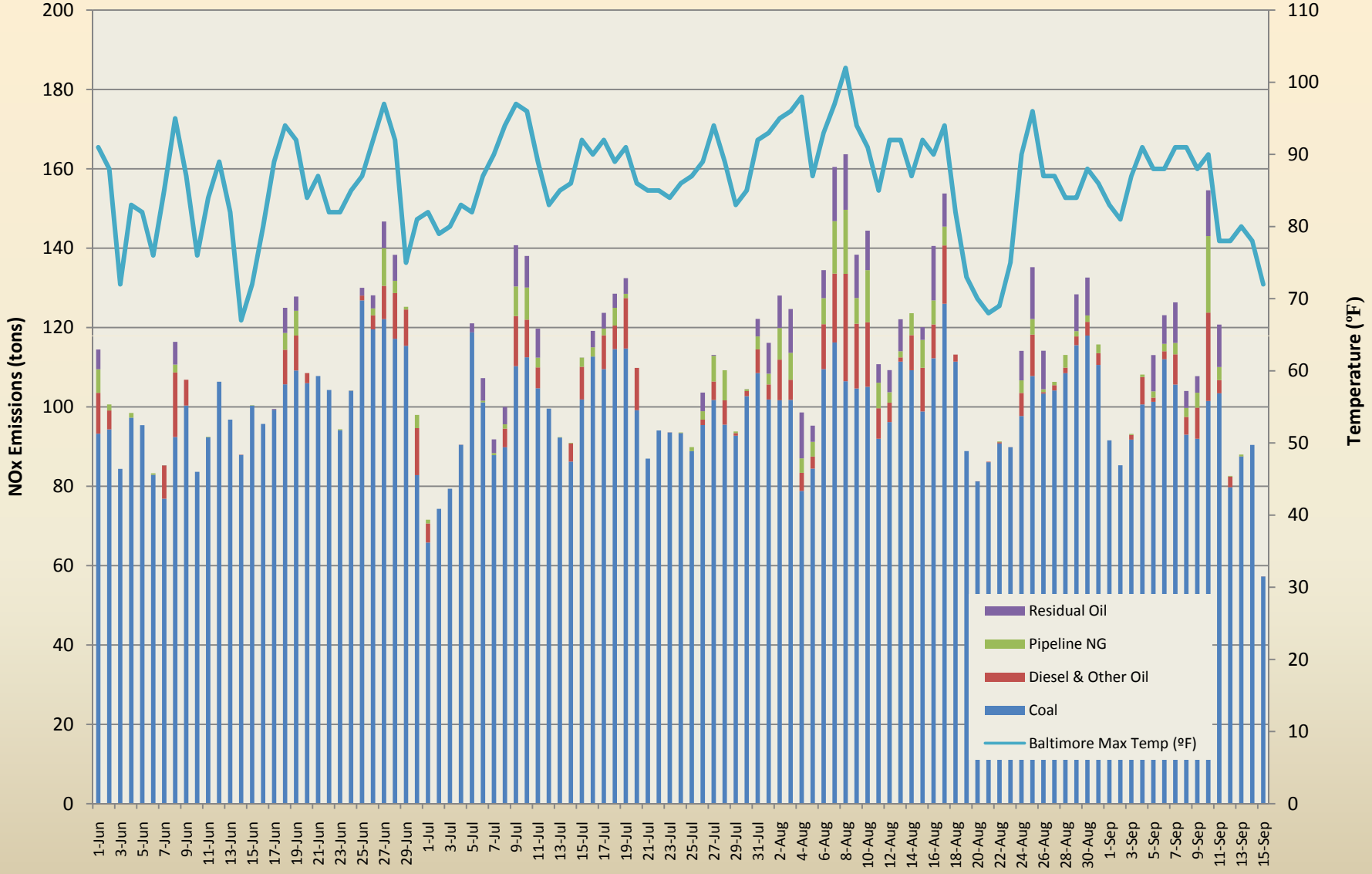
Daily NOx Emssions from EGUs in LADCO States

(June 1, 2007 - September 15, 2007)



Daily NOx Emissions from Maryland EGUs

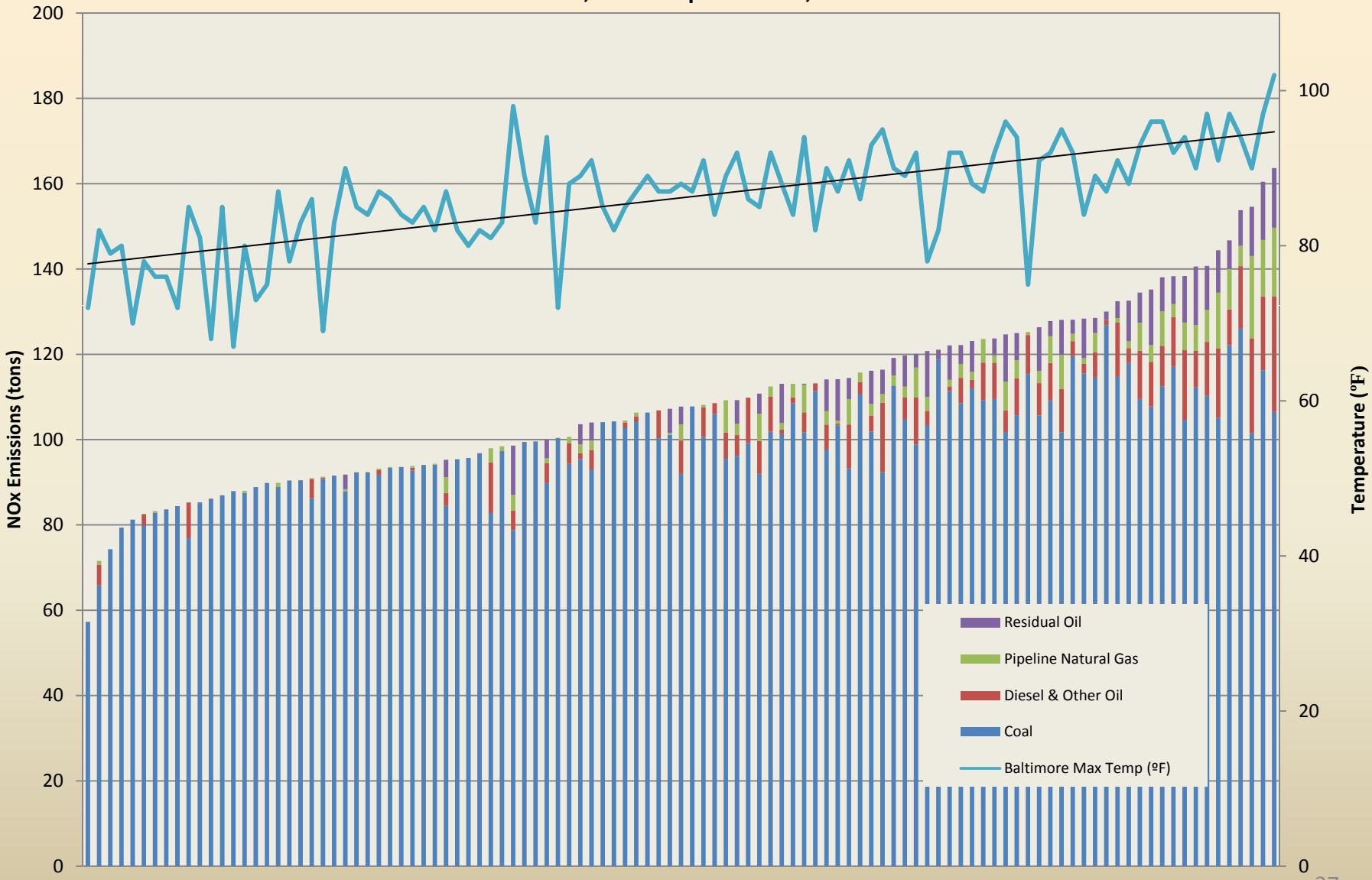
June 1, 2007 - Sept 15, 2007



Daily NOx Emissions from Maryland EGUs

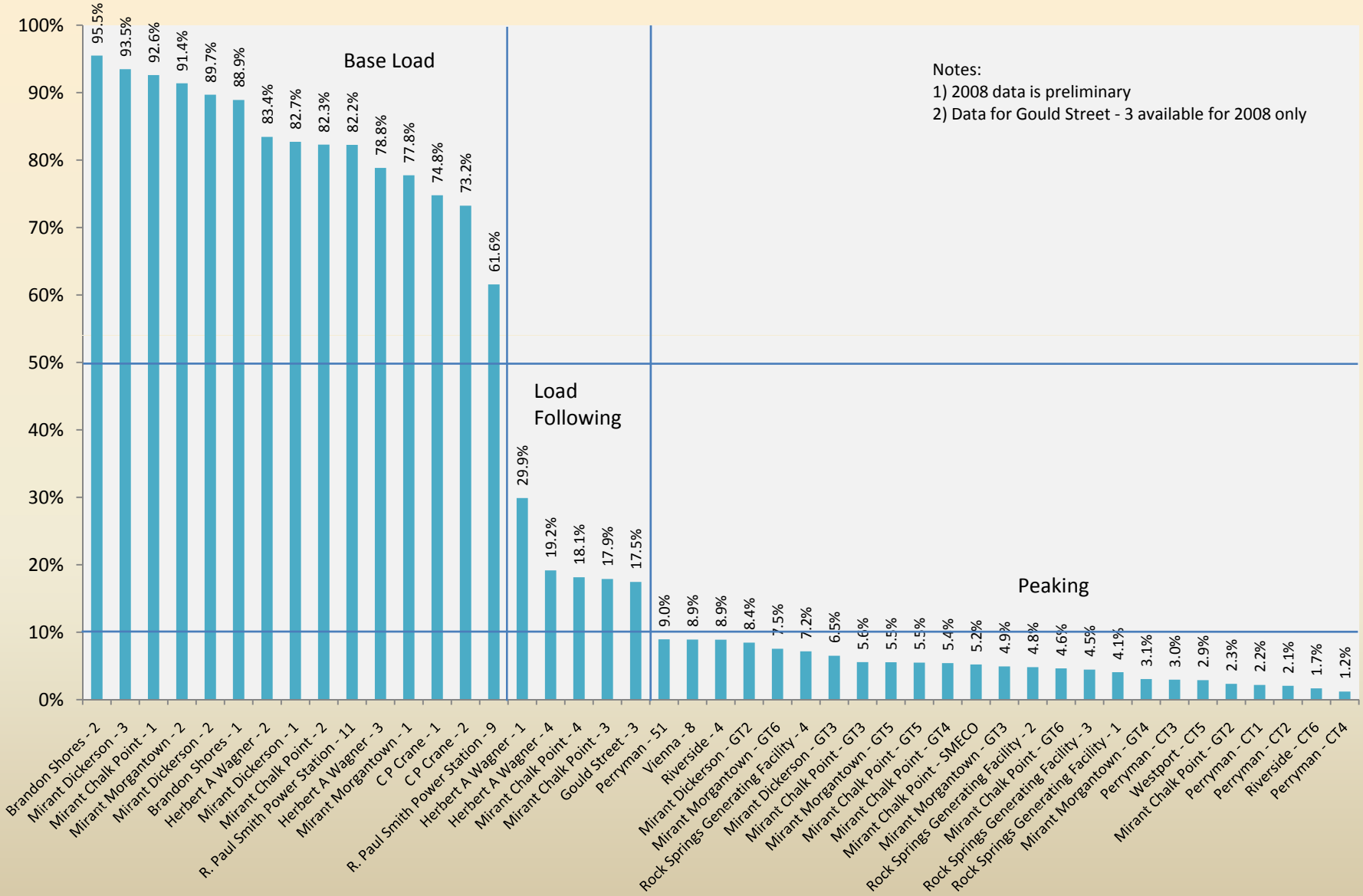
Sorted by Total EGU NOx Emissions

June 1, 2007 - September 15, 2007



Maryland EGU Average Operating Time

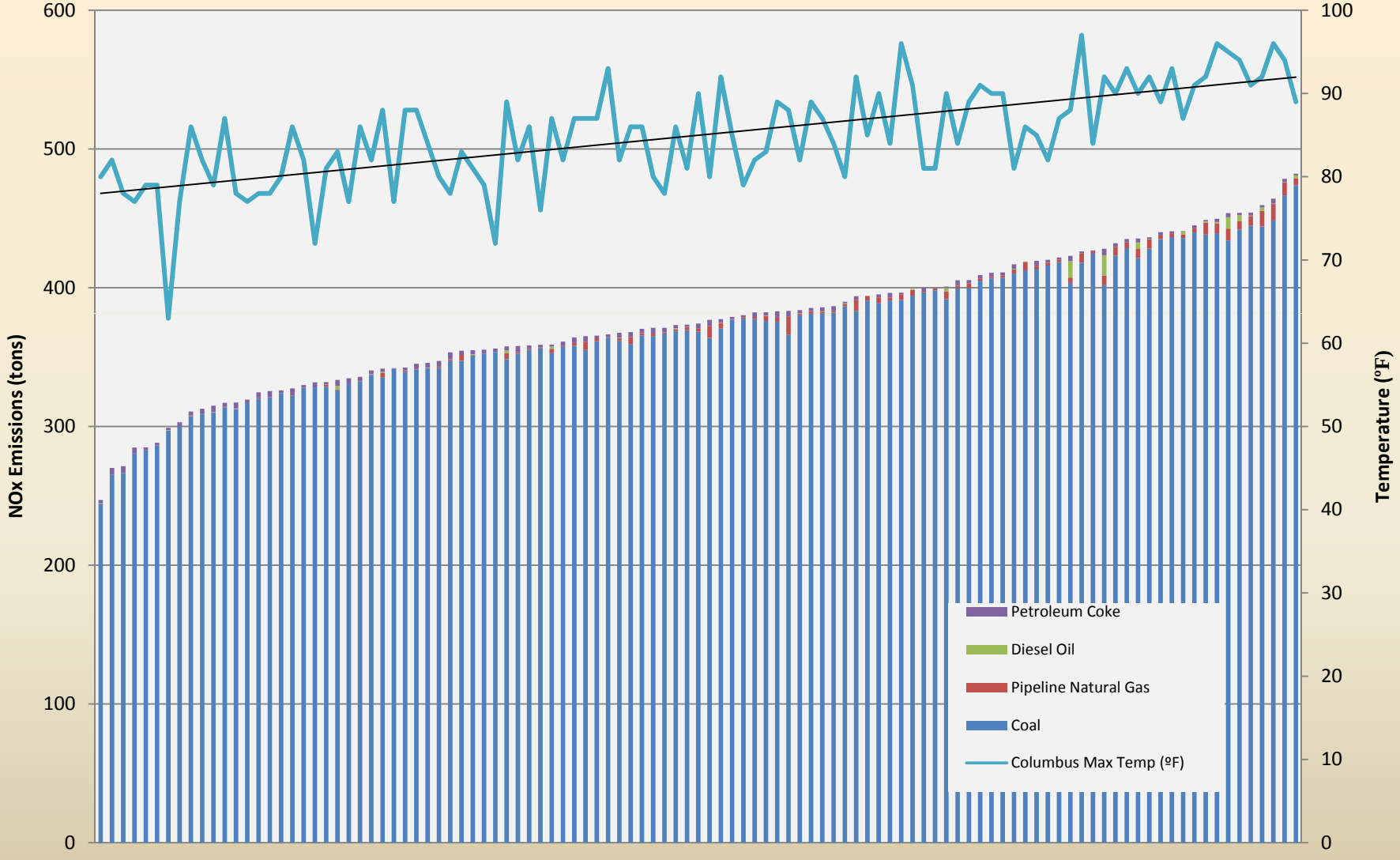
2006 - 2008 Ozone Season



Daily NOx Emissions from Ohio EGUs

Sorted by Total EGU NOx Emissions

(June 1, 2007 - September 15, 2007)



Daily NOx Emissions from Ohio EGUs

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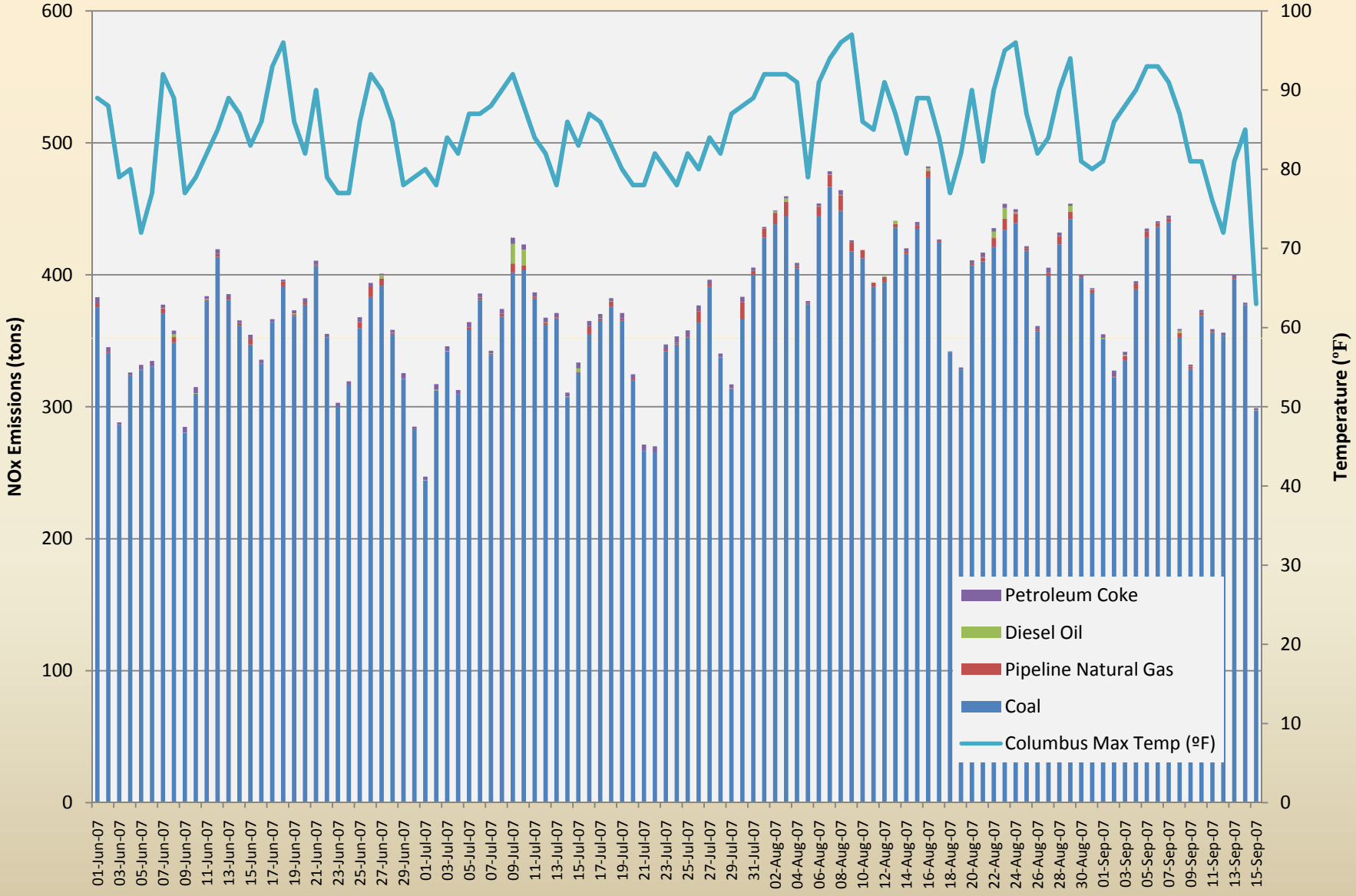
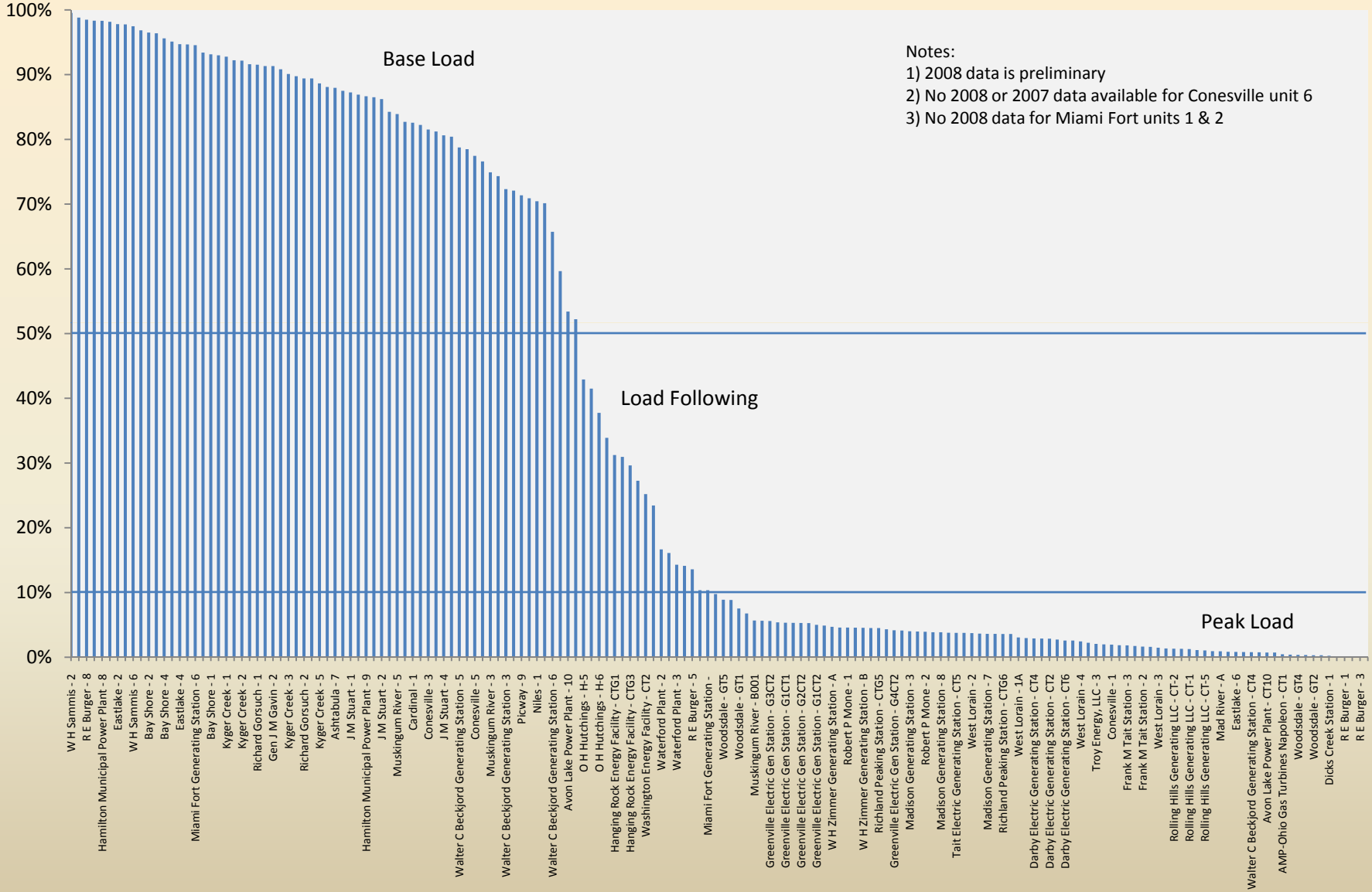


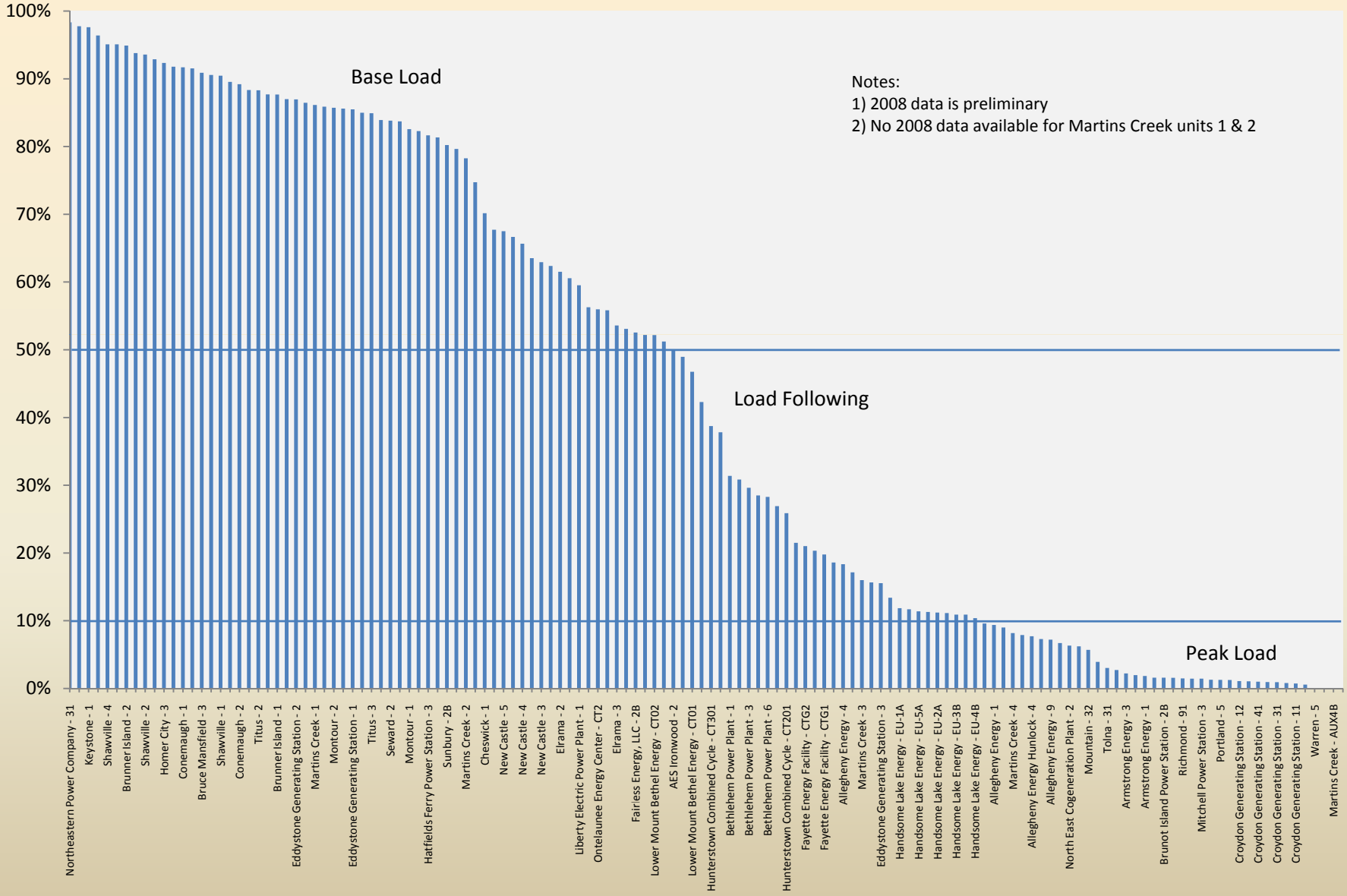
Ohio Average EGU Operating Time (%)

2006 - 2008 Ozone Seasons



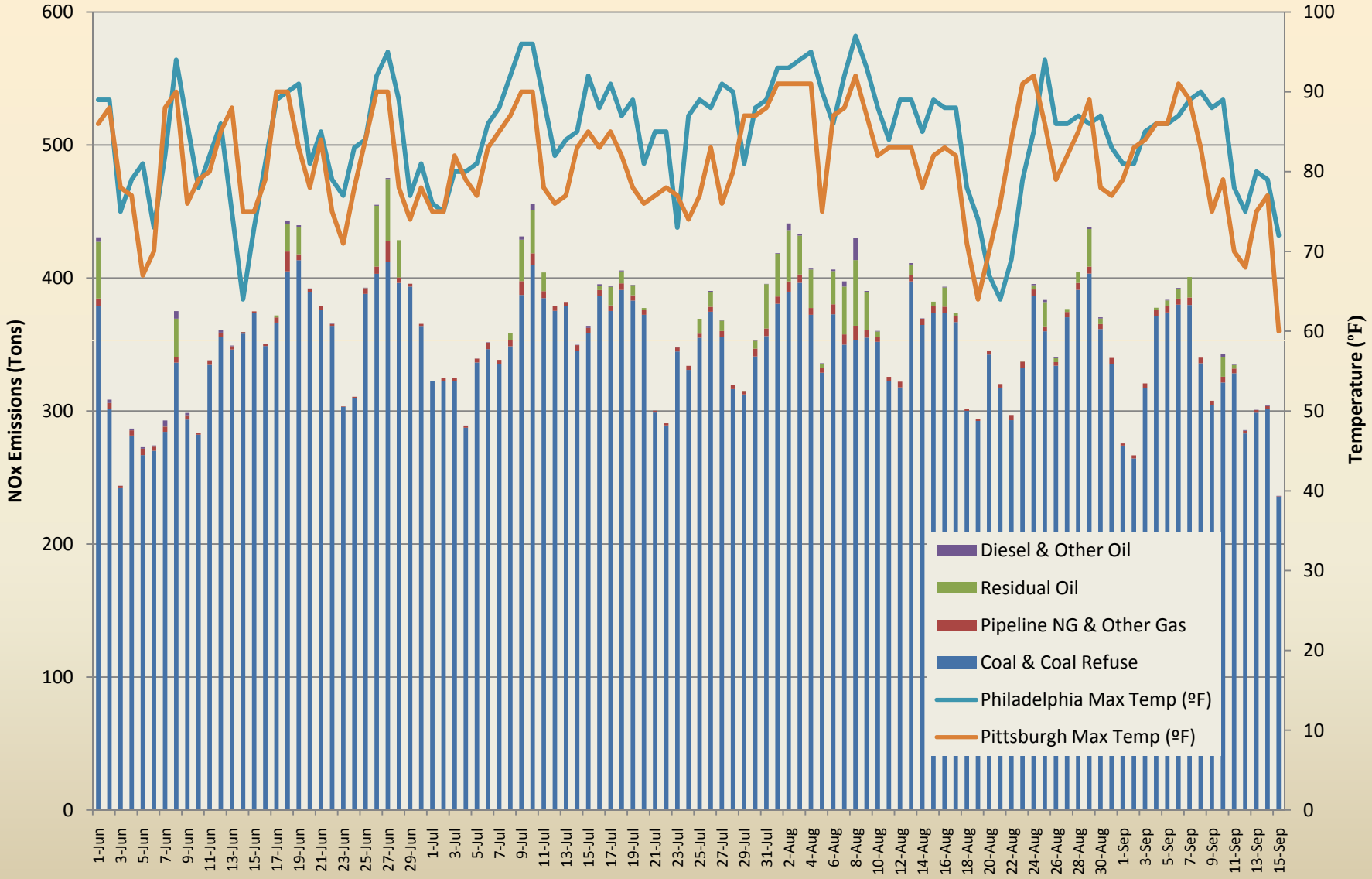
Pennsylvania Average EGU Operating Time (%)

2006 - 2008 Ozone Seasons



Daily NOx Emissions from Pennsylvania EGUs

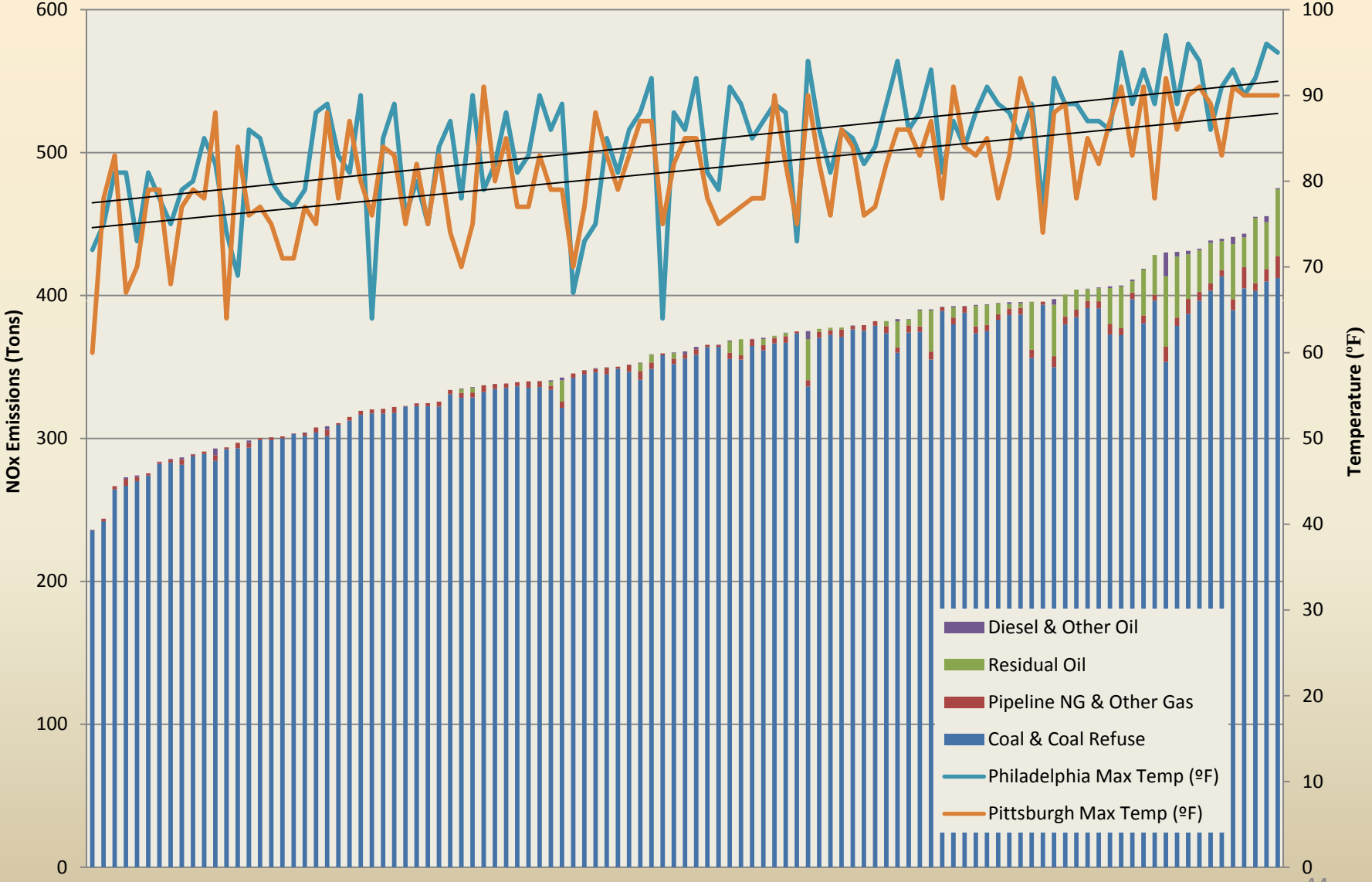
June 1, 2007 - September 15, 2007



Daily NOx Emissions from Pennsylvania EGUs

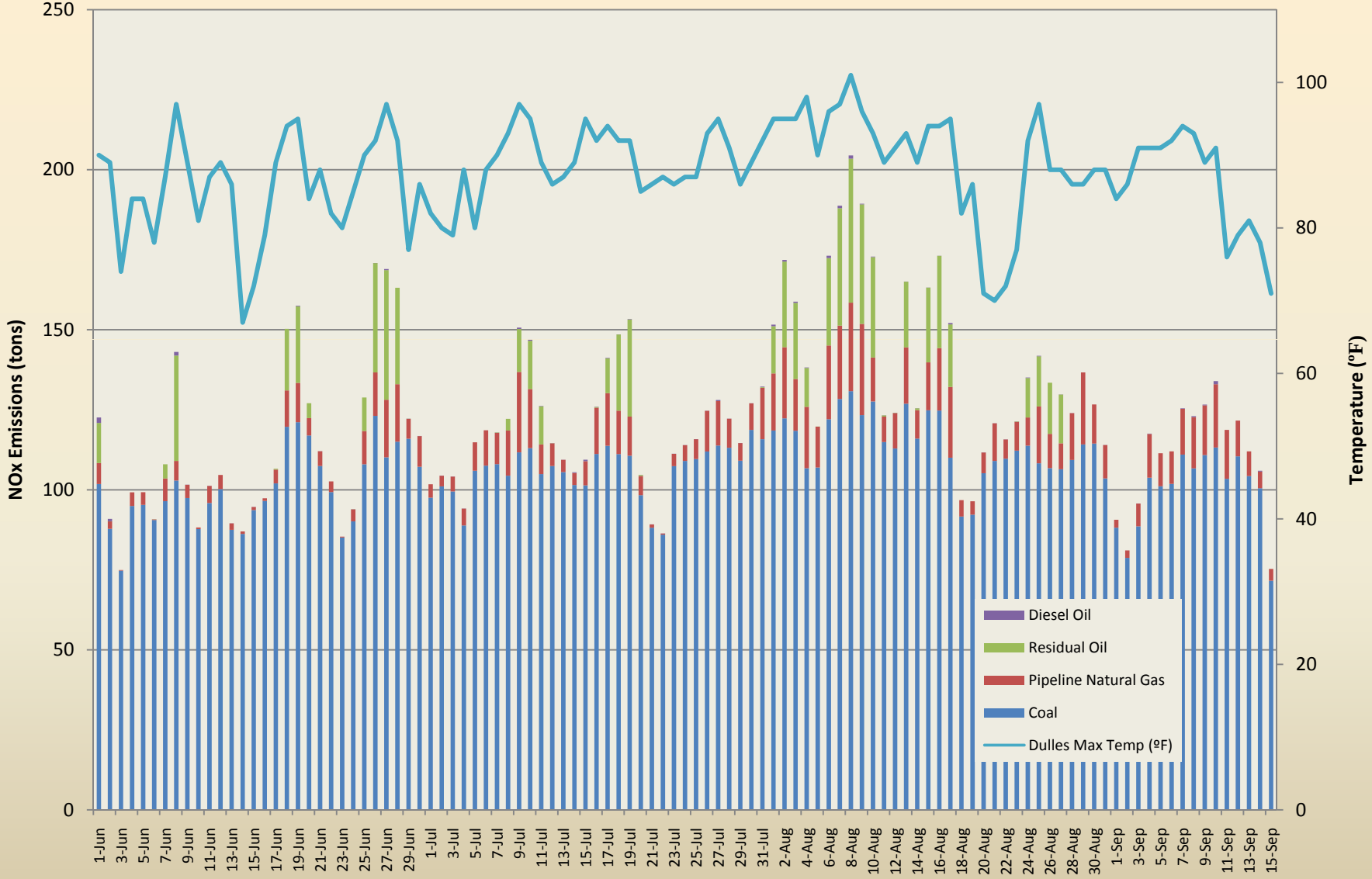
Sorted by Total EGU NOx Emissions

June 1, 2007 - September 15, 2007



Daily NOx Emissions from Virginia EGUs

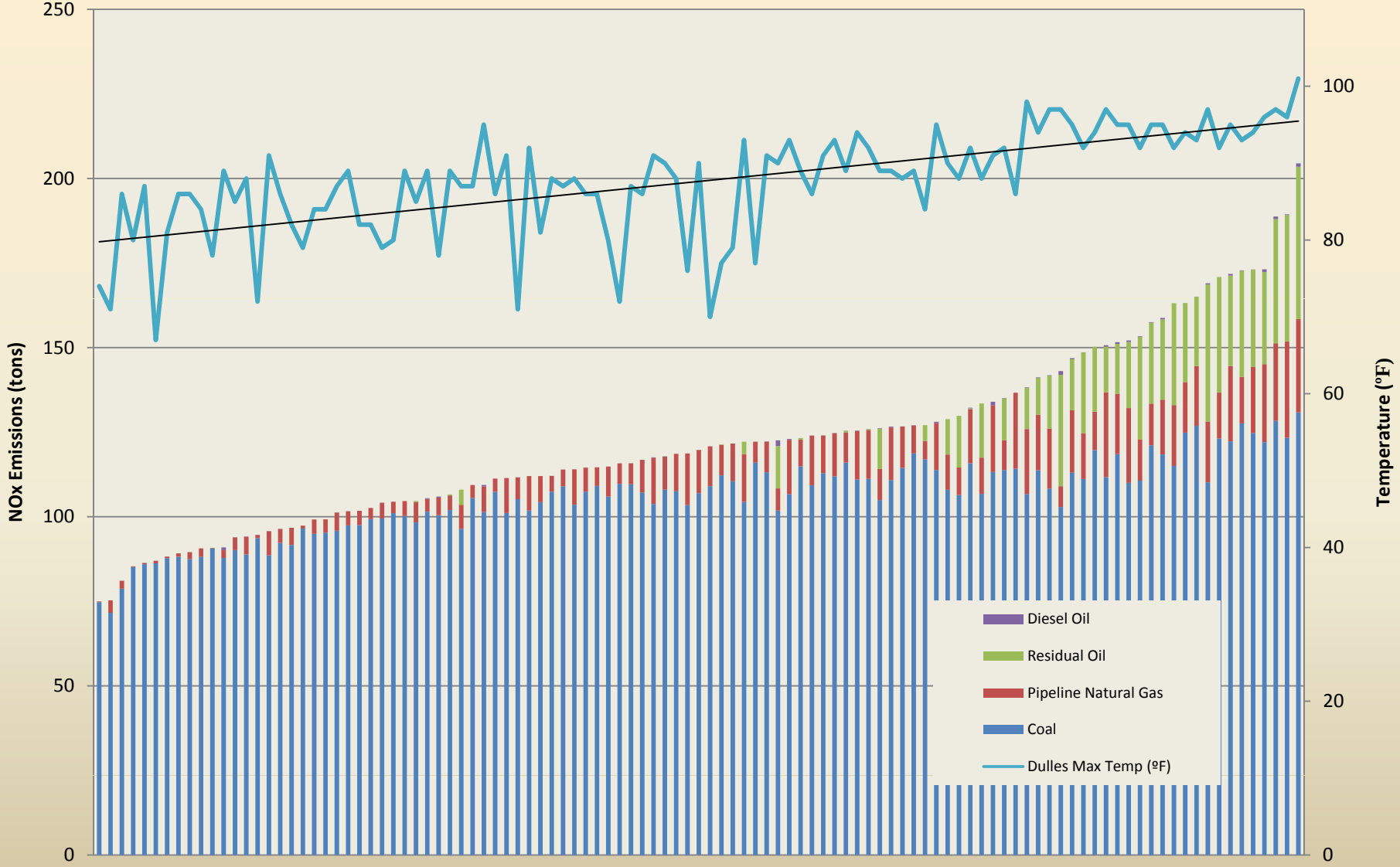
June 1, 2007 - Sept 15, 2007



Daily NOx Emissions from Virginia EGUs

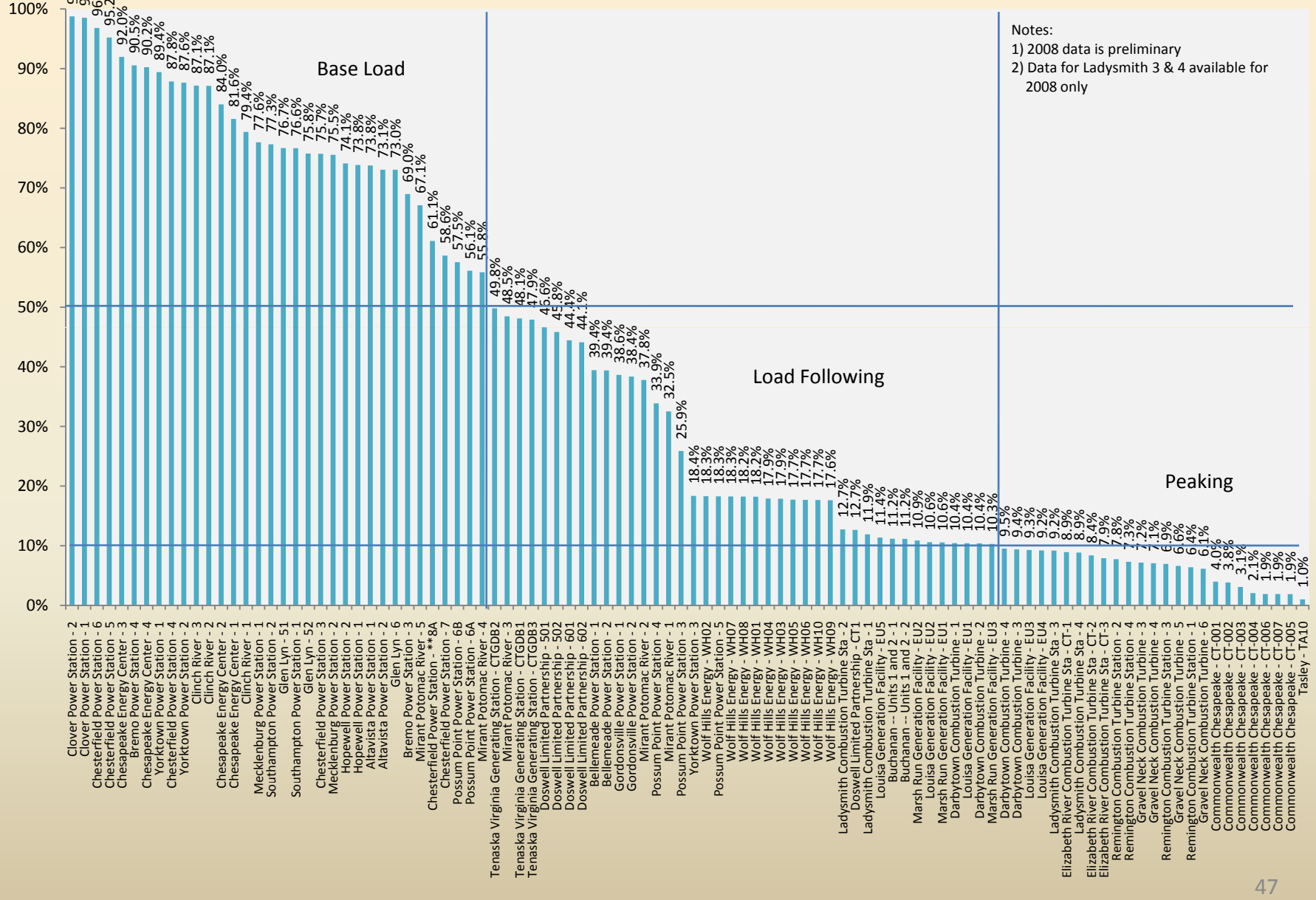
Sorted by Total EGU NOx Emissions

June 1, 2007 - September 15, 2007



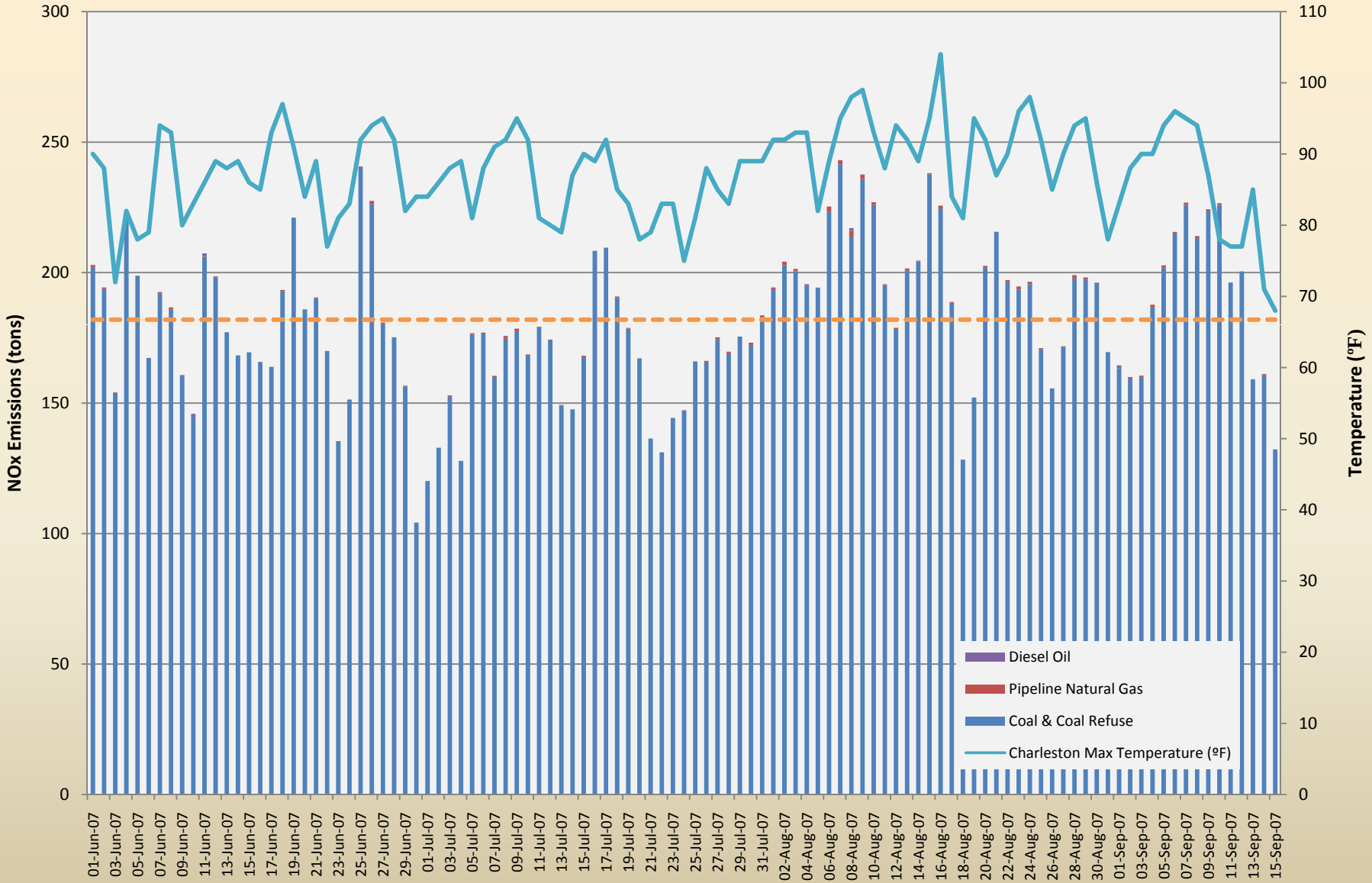
Virginia EGU Average Operating Time

2006 - 2008 Ozone Season

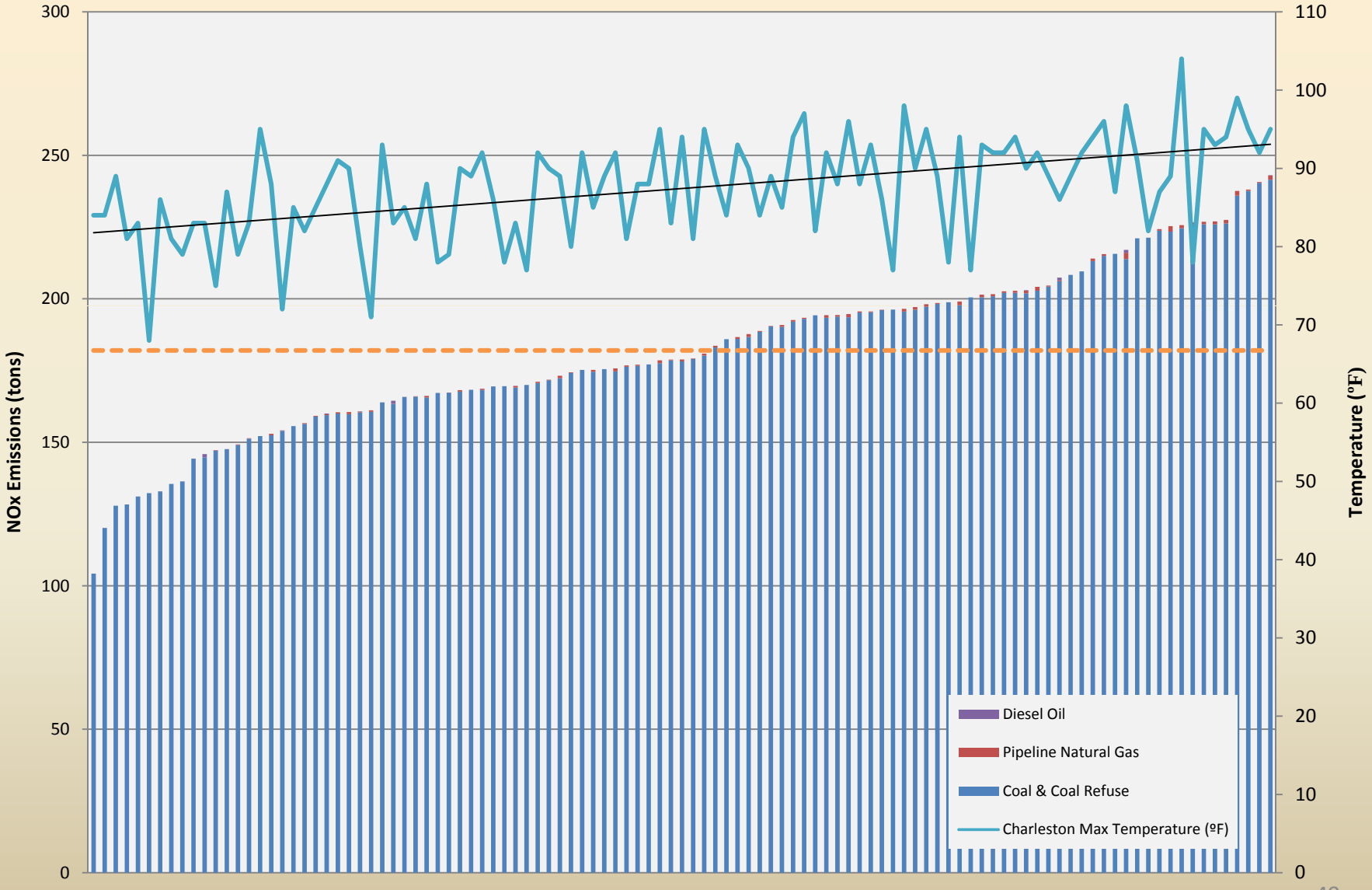


Daily NOx Emissions from West Virginia EGUs

(June 1, 2007 - September 15, 2007)



Daily NOx Emissions for West Virginia EGUs

Sorted by Total Daily NOx Emitted

(June 1, 2007 - September 15, 2007)