Big Push
Air Quality Modeling with Source Apportionment

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Presentation Outline

- NAAQS for Ozone
- Design Value Trends at Audubon and Murchison
- Study Goals
- CAMx Photochemical Model and Modeling Episodes
- Austin Sources and Receptor Areas
- APCA Source Apportionment Modeling
- Time of Day Contributions Modeling
- Environmental Dispatch Modeling

EPA Revises NAAQS for Ground-Level Ozone

- Previous (established 1997) primary and secondary NAAQS for ozone concentrations averaged over 8 hours was 0.08 parts per million (ppm).
  - Due to rounding, standard was effectively 85 ppb.

- On March 17, 2008, EPA revised the primary NAAQS for ozone concentrations averaged over 8 hours to 0.075 ppm (75 ppb). The secondary standard was set at a form and level identical to the primary standard.

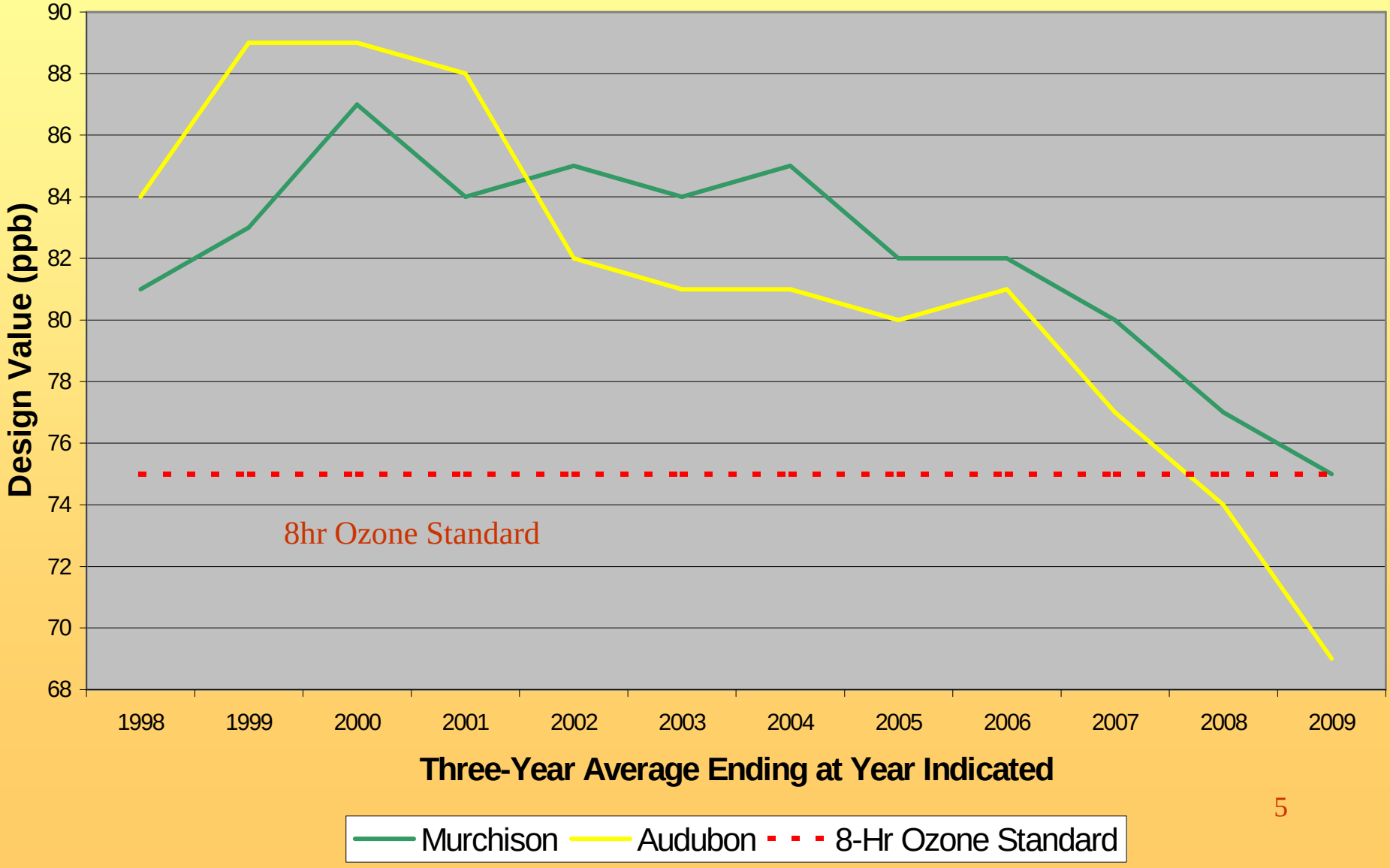
- On September 16, 2009, EPA announced it would reconsider both the primary and secondary NAAQS for ozone.

Implementation Schedule for the Revised Ozone NAAQS

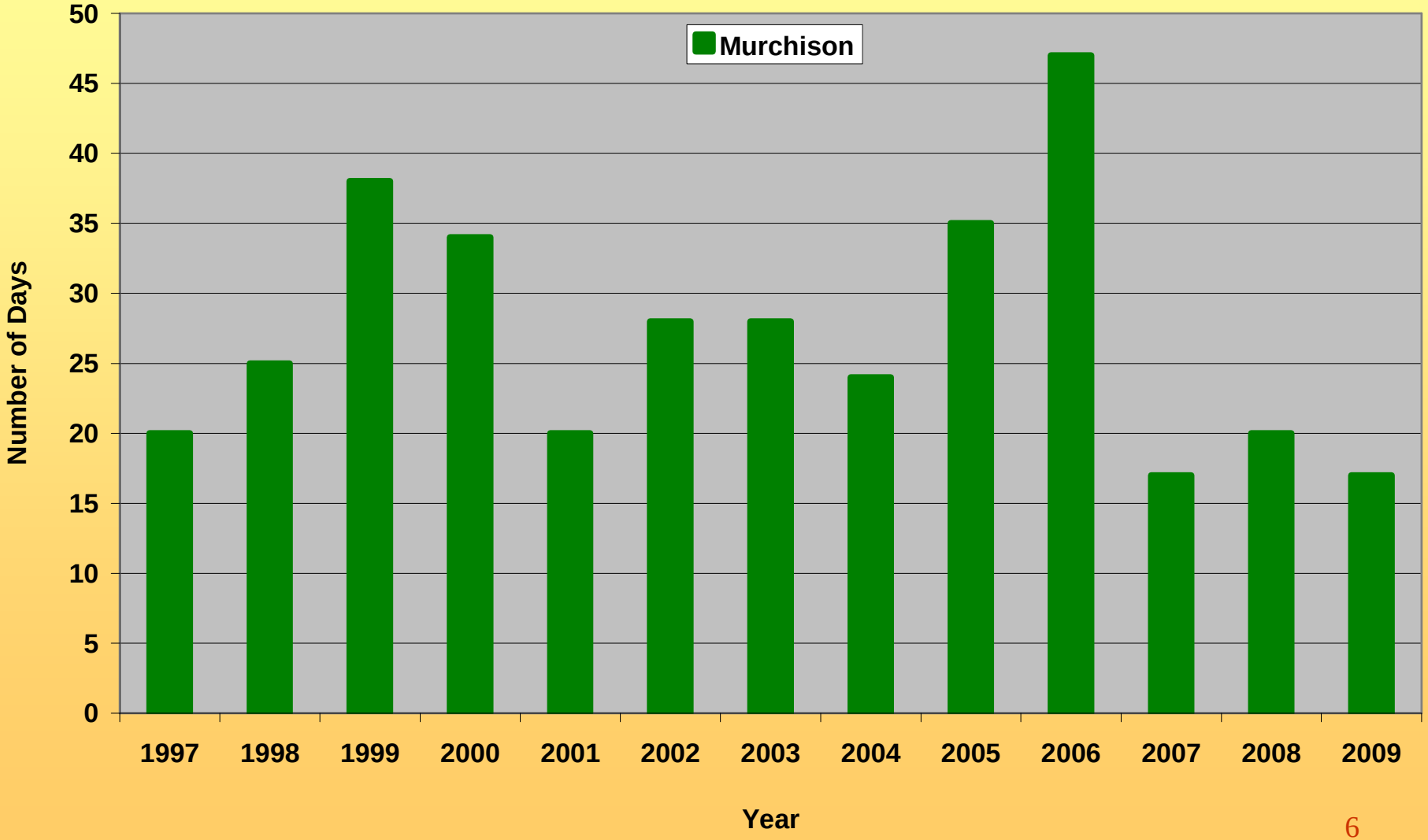
- EPA will propose revisions to the primary and (potentially) secondary standards by December 2009 with a final decision by August 2010.
  - EPA notes that the standards set in 2008 were not as protective as recommended by EPA's Clean Air Scientific Advisory Committee (CASAC).
  - CASAC had recommended a primary standard (human health-based) in the range of 60 ppb to 70 ppb.
  - CASAC had recommended a cumulative form for the secondary standard (welfare-related) that limited the "W126" index within a range of 7 – 15 ppm-hours, accumulated over at least 12 "daylight" hours and the three maximum ozone months of the summer growing season.
- EPA and States to complete final designations by August 2011.
- States to submit SIPs outlining how they will reduce pollution to meet the revised ozone NAAQS by December 2013.

Austin Monitor Design Value Trends

8-Hr Maximum Ozone Design Values



Annual Number of Days at Murchison with Daily Maximum 8-Hour Ozone Concentrations >= 65 ppb



Austin Attainment?

Based on 2006 through 2008 Monitoring Data:

- Audubon Design Value is 74 ppb (69 ppb after 2009)
- Murchison Design Value is 77 ppb (75 ppb after 2009)
- In May, we wanted to answer the question: Are there actions we could take during the 2009 Ozone Season to help bring Murchison into attainment and maintain attainment at Audubon?

Air Quality Modeling Study Goals

1. Question: How much do NOx emissions from local Austin sources contribute to daily maximum 8hr ozone concentrations at Austin's Regulatory Air Quality Monitors?
   - Air Quality Modeling to track NOx emissions from Austin point sources and predict the individual source contributions to ozone formation in Austin.
2. Question: Is Environmental Dispatch an effective way of reducing ozone? Will shifting generation from a source with a large contribution to a source with a small contribution reduce ozone while meeting electricity demand?
   - Step 1: Air Quality Modeling to Determine Time of Day Contributions and design Environmental Dispatch
   - Step 2: Air Quality Modeling to evaluate Environmental Dispatch Scenarios

Photochemical Modeling

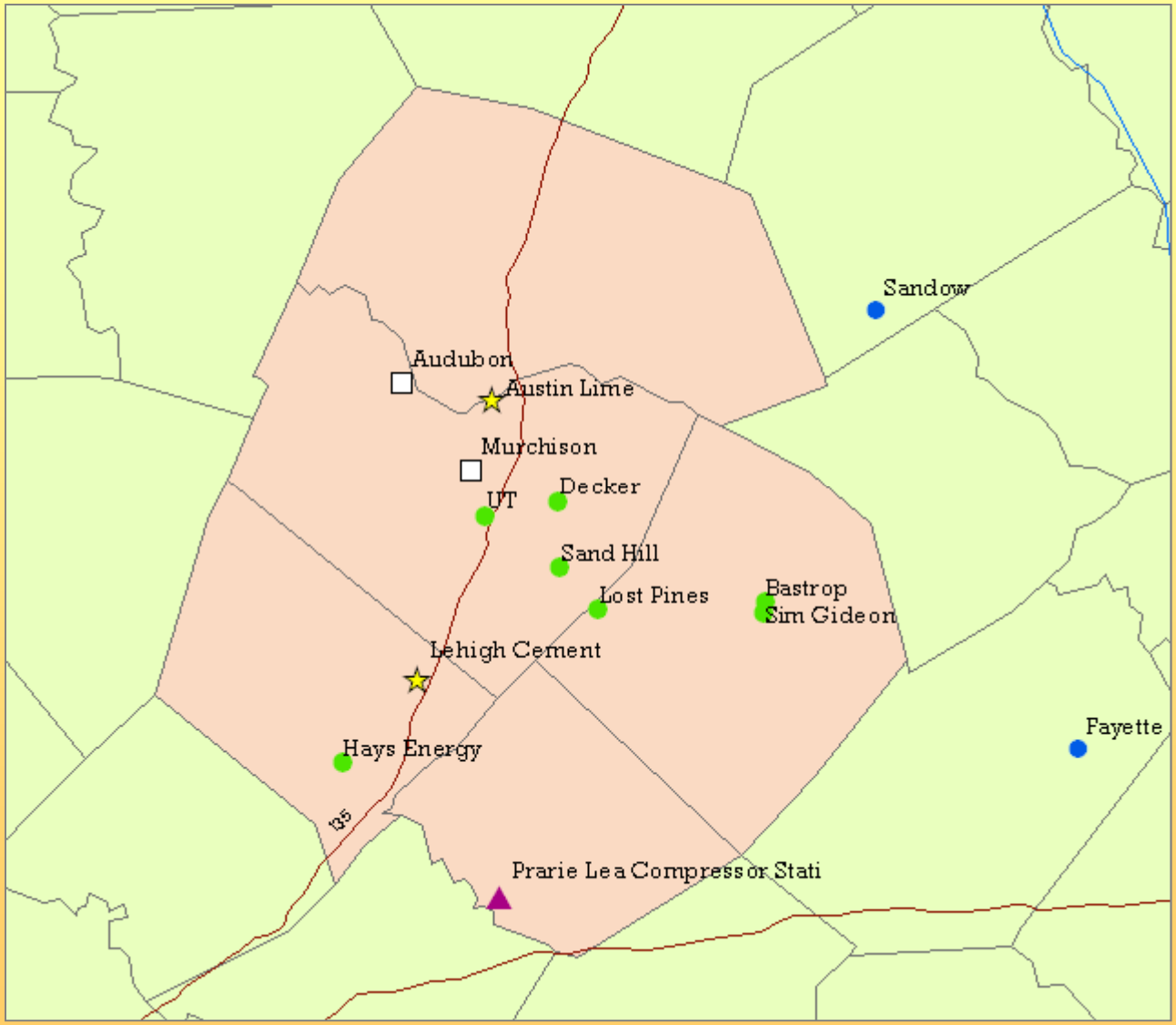
- The Comprehensive Air Quality Model with Extensions (CAMx) was used to perform the photochemical grid modeling for this project.
- CAMx is a three-dimensional Eulerian photochemical grid model that determines concentrations of aerosol and/or gas-phase pollutants by simulating processes associated with emissions, transport, chemistry, and dry or wet deposition.
- CAMx is the preferred model used by TCEQ for Texas attainment demonstrations.

CAMx Modeling Episodes

Two Unique Episodes

1. CENRAP 2002 June through September "Seasonal" Episode with 2002 Meteorology and 2009 Emissions Inventory
   - Developed for visibility studies, updated in 2006 by ENVIRON to include ozone modeling
   - Used by the TCEQ in support of the Dallas SIP
   - The model domain is a nested 36-km/ 12-km grid.
2. Early Action Compact Sept. 13-20th, 1999 Episode with 1999 Meteorology and 2007 "Future Case" Emissions Inventory
   - Developed using EPA guidelines for SIP modeling
   - Used by the TCEQ to evaluate control strategies to help Austin remain in attainment of 8-hr ozone standard
   - Episode includes meteorological regimes typical of ozone exceedances in the Austin area
   - The model domain is a nested regional/urban scale 36-km/12-km/4-km grid.

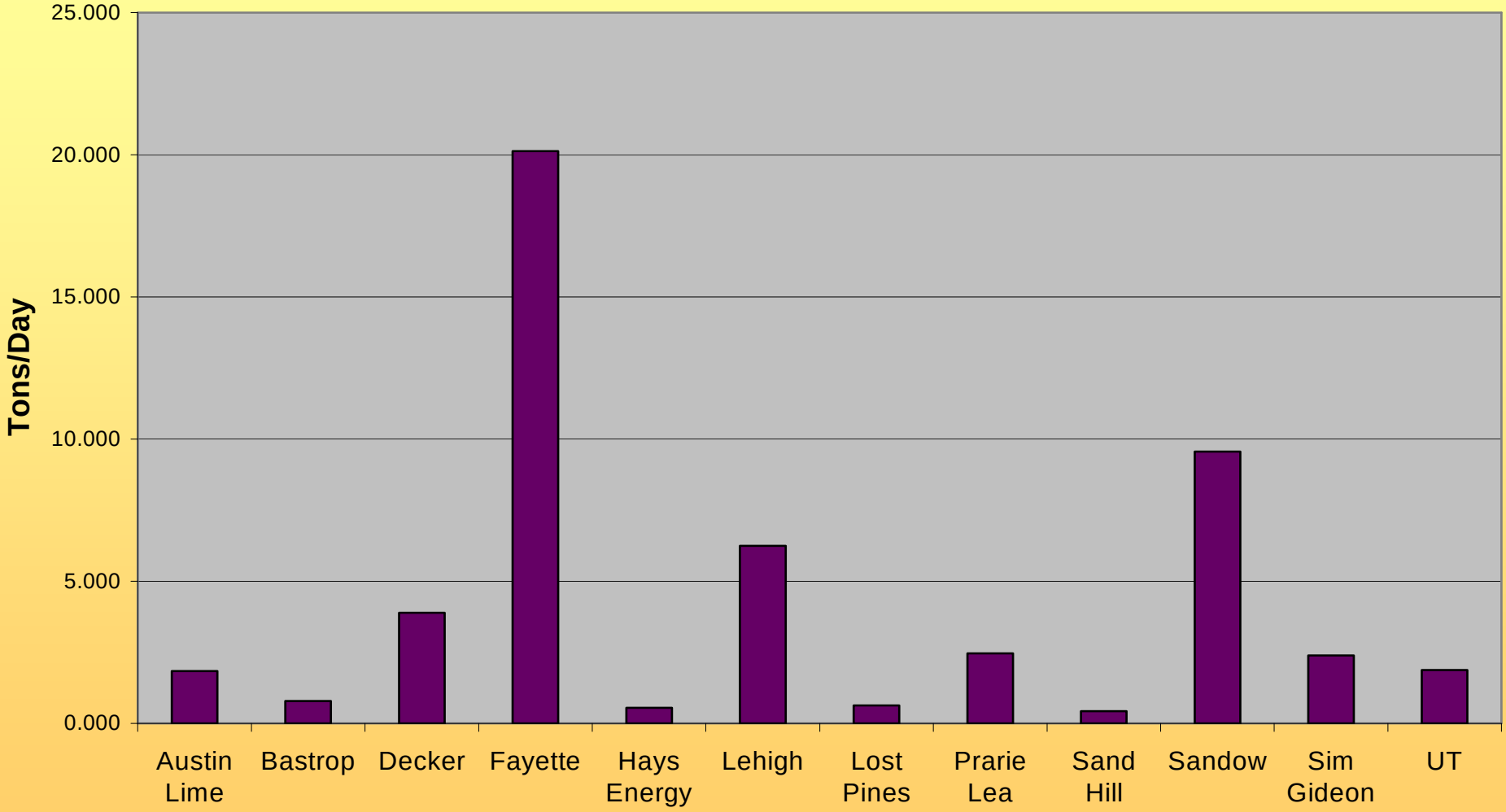
Austin Elevated Point Sources of Interest



Legend

- Natural Gas Power Plants
- Coal-Fired Power Plants
- Compressor Station
- Cement Kilns
- Monitors

Early Action Compact Modeled Daily NOx Emissions Rates for the Austin Sources



*Emissions for EGUs are based on 2008 EI provided by AE

**Emissions for Prarie Lea, Austin Lime and Lehigh were based on 2006 EI provided by CAPCO.

Austin Source Contribution Air Quality Modeling

1. **Question: How much do NOx emissions from local Austin sources contribute to daily maximum 8hr ozone concentrations at Austin's Regulatory Air Quality Monitors?**
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Air Quality Modeling w/ APCA

(Anthropogenic Precursor Culpability Assessment)

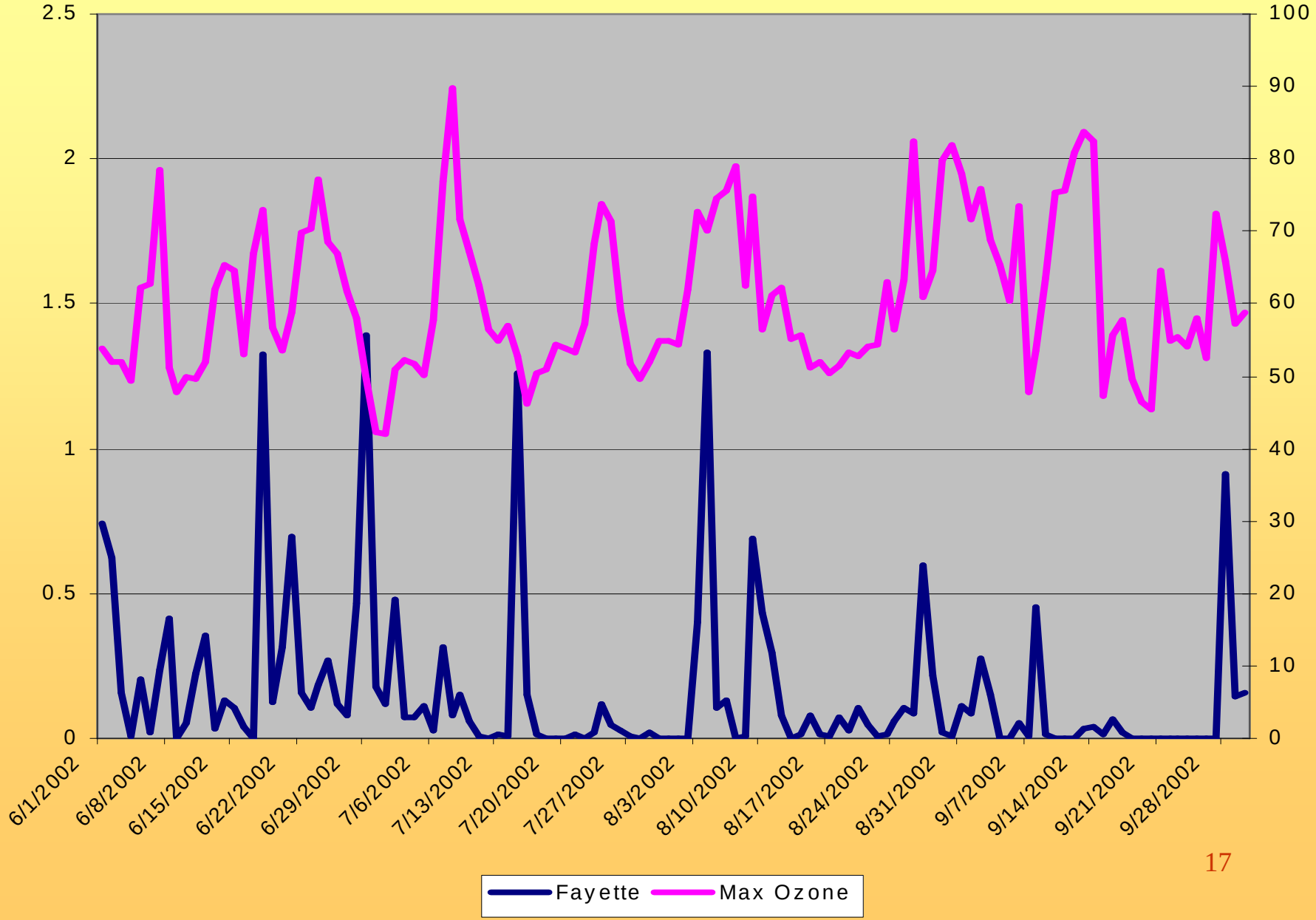
- APCA is a variation of Ozone Source Apportionment Technology (OSAT) and provides a method for estimating contributions to ozone concentrations from multiple source groups.
- For each source, APCA uses ozone reaction tracers to track the fate of ozone precursor emissions of VOCs and NOx as well as ozone formation attributed to these emissions.
- For both the 2009 Seasonal runs and the 2007 EAC runs, APCA was used to track:
  - Daily Emissions from 12 Austin Elevated Point Sources
    - 9 EGUs
    - 2 Cement Kilns
    - 1 Compressor Station
  - All other Elevated Point Source Emissions
  - All Anthropogenic Surface Emissions (e.g., mobile, nonroad, low-level point, and area sources) in the entire modeling domain
  - Biogenic Emissions (interaction of biogenic VOC and biogenic NOx only)
  - Boundary and Initial Conditions

Receptor Areas

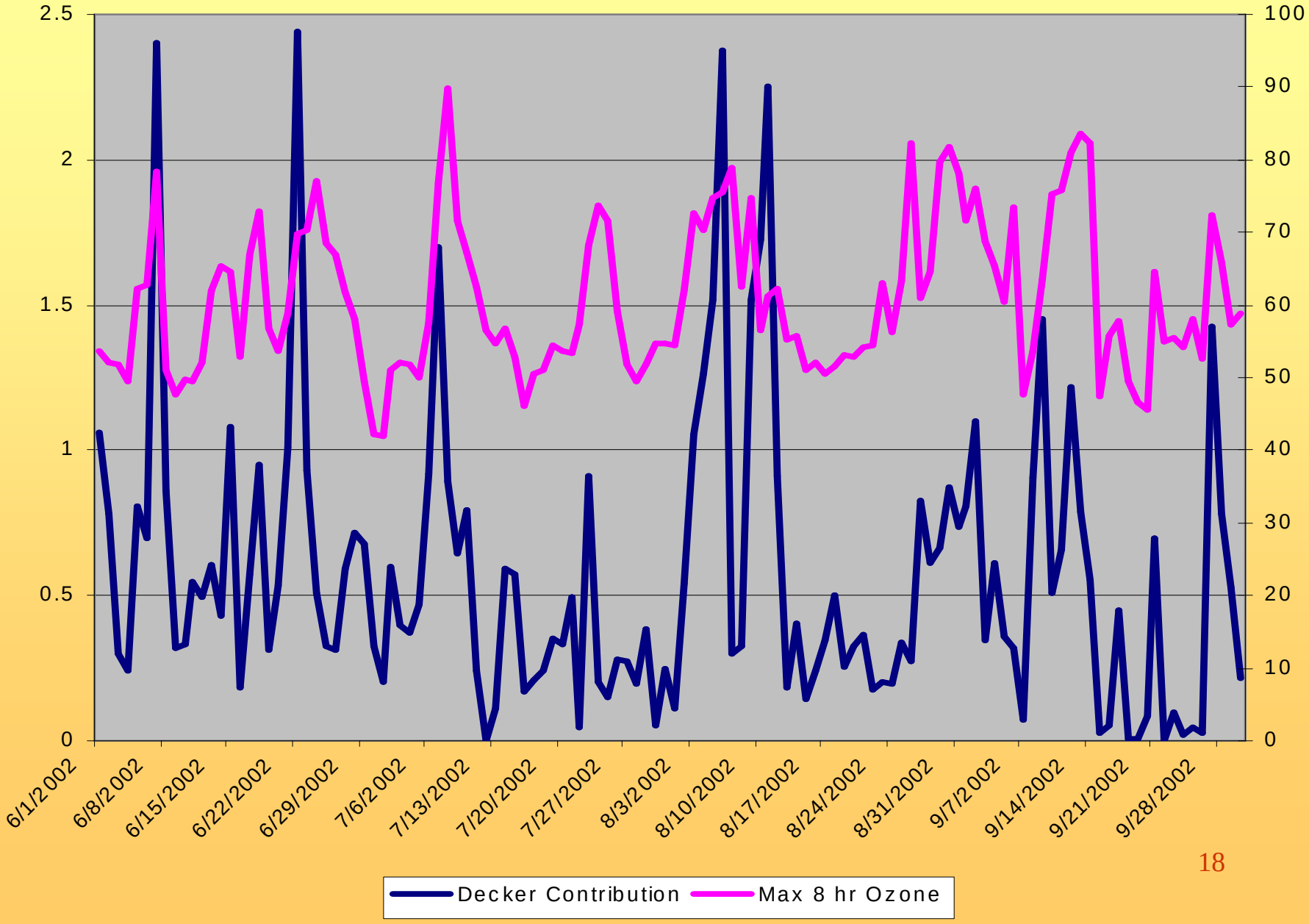
- Receptor Areas for Source Apportionment Analysis:
  1. Audubon
  2. Murchison
  – For both monitors, receptor areas were defined according to EPA guidance
    – Seasonal Model: 3x3 12km grid cells centered on monitoring station
    – EAC: 7x7 4km grid cells centered on monitoring station
  3. All grid cells within the five county Austin Area
- Results were similar for both monitors.
- Murchison is the controlling regulatory monitor so results are presented for Murchison only.
- Results for Audubon and the five county area available.

Seasonal Episode Modeling Results

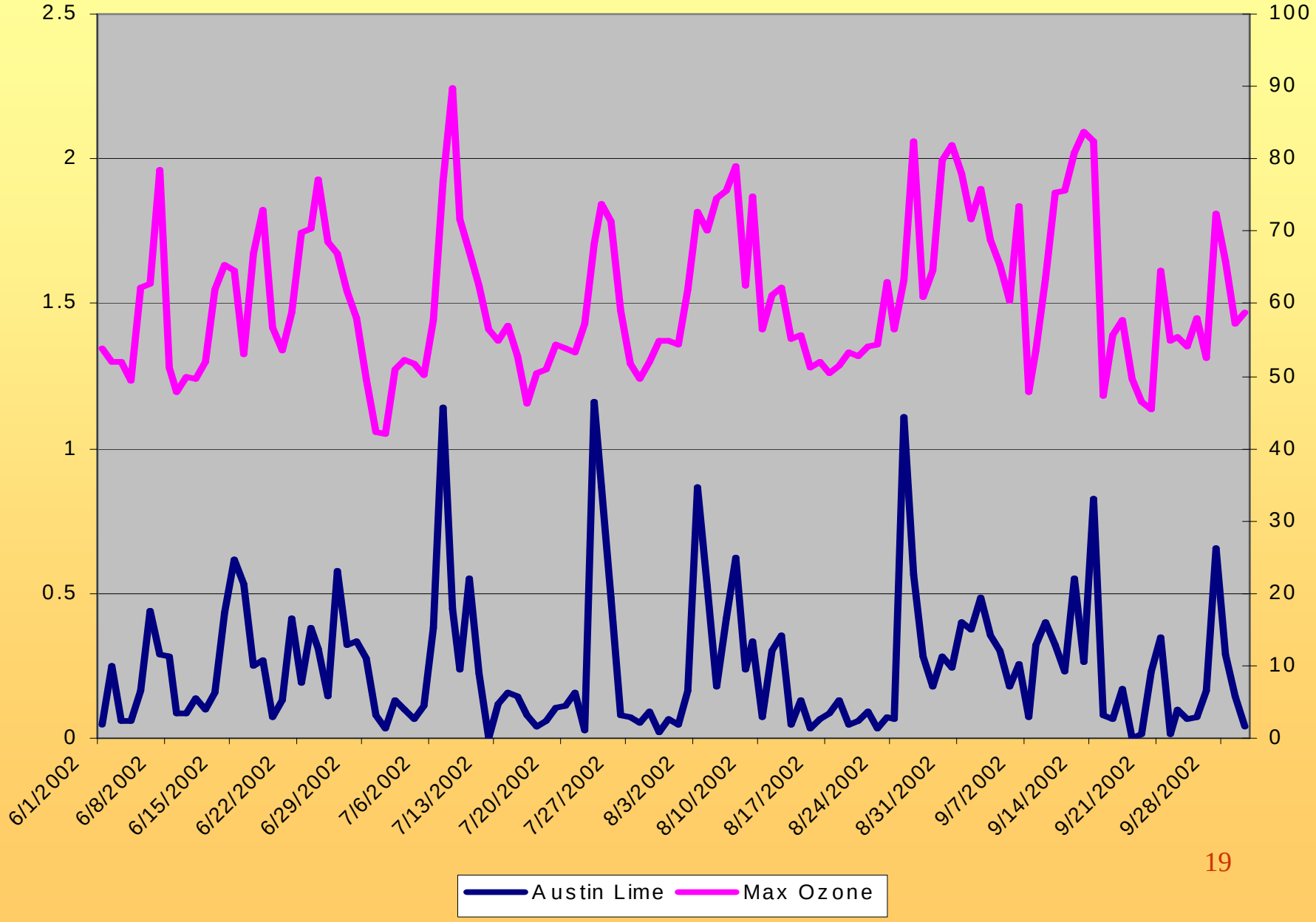
Fayette Contribution to Max 8hr Ozone (ppb)



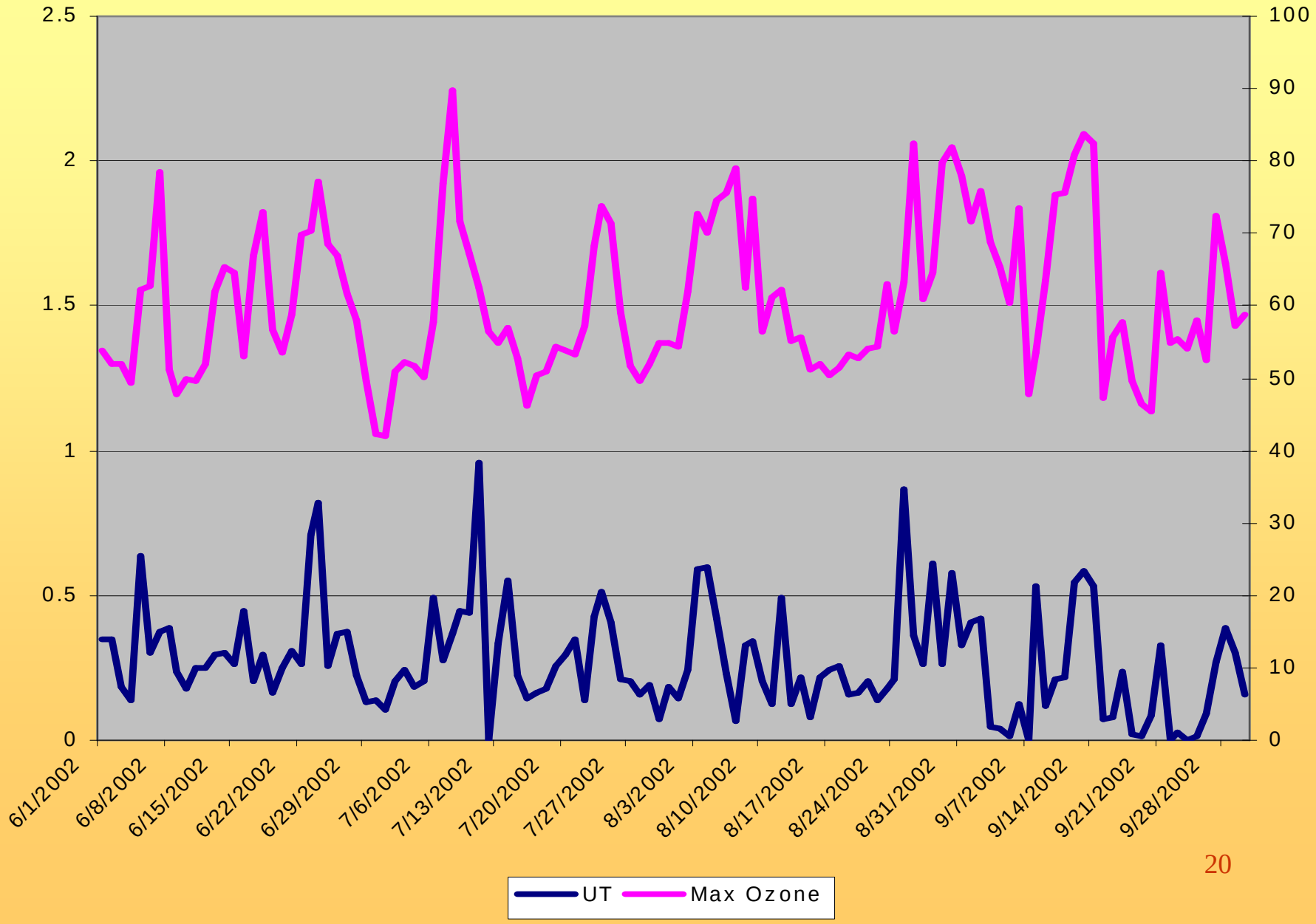
Decker Total Daily Contribution to Max 8hr Ozone (ppb)



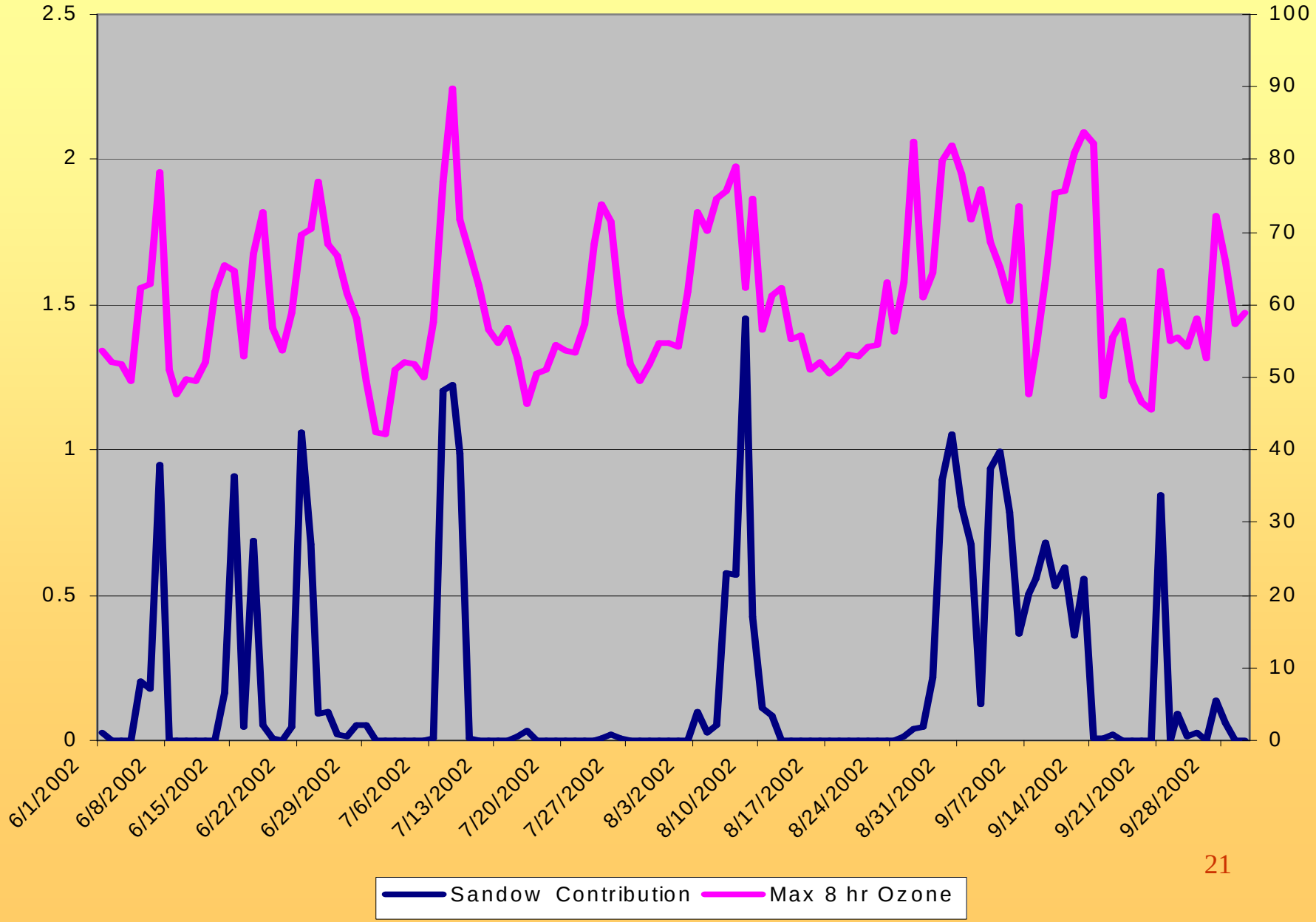
Austin Lime Contribution to Max 8hr Ozone (ppb)



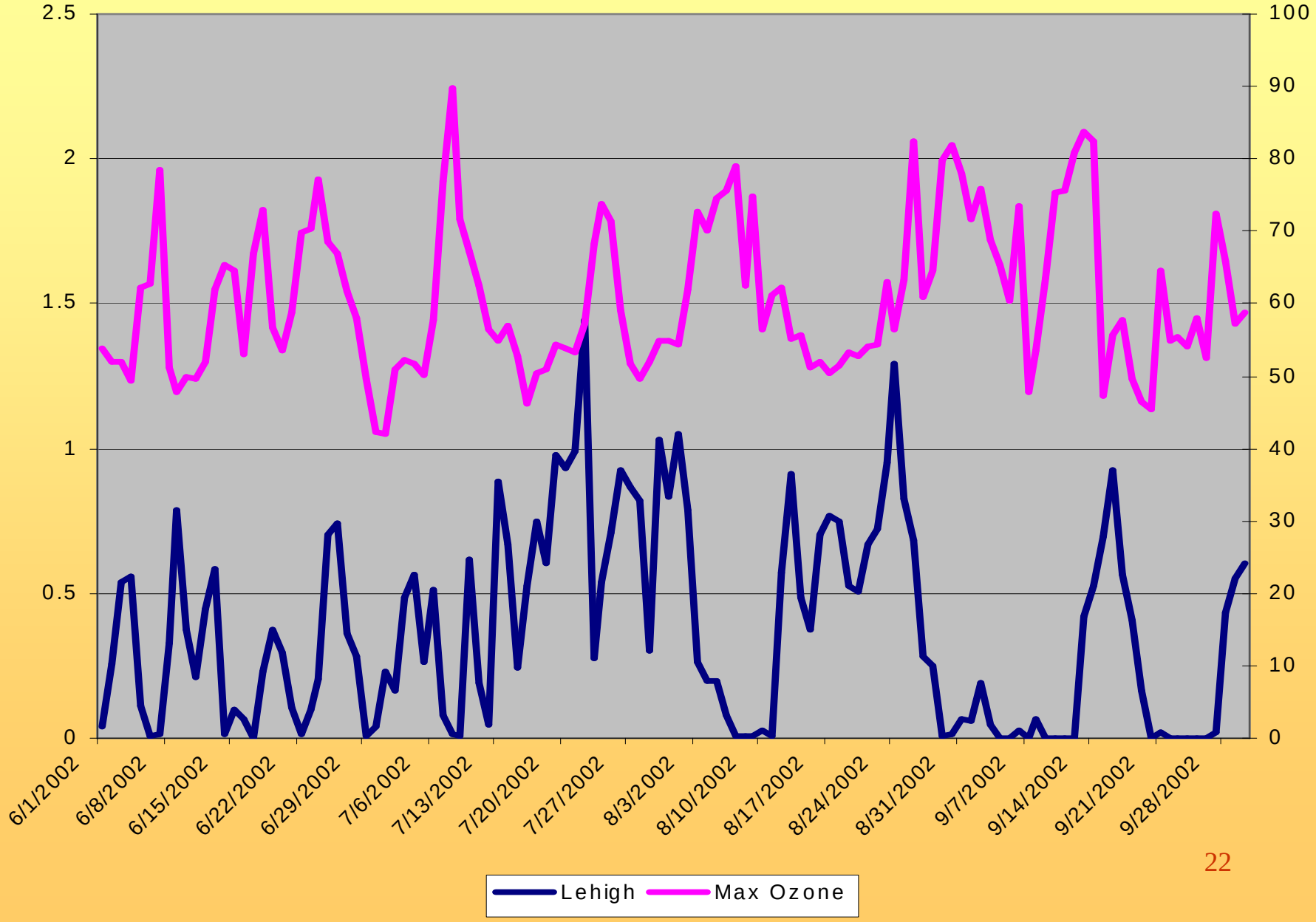
UT Power Plant Contribution to Max 8hr Ozone (ppb)



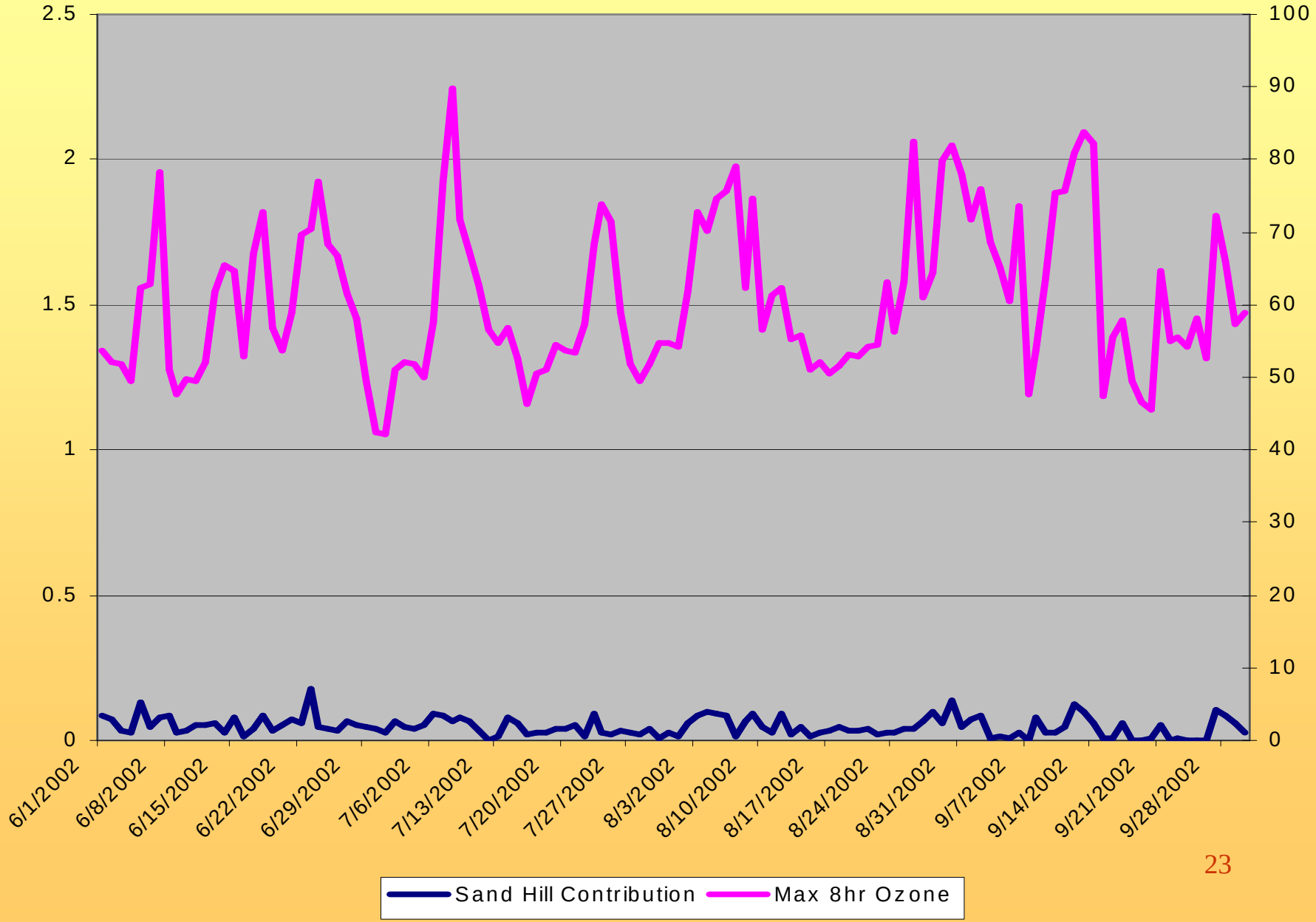
Sandow Contribution to Max 8hr Ozone (ppb)



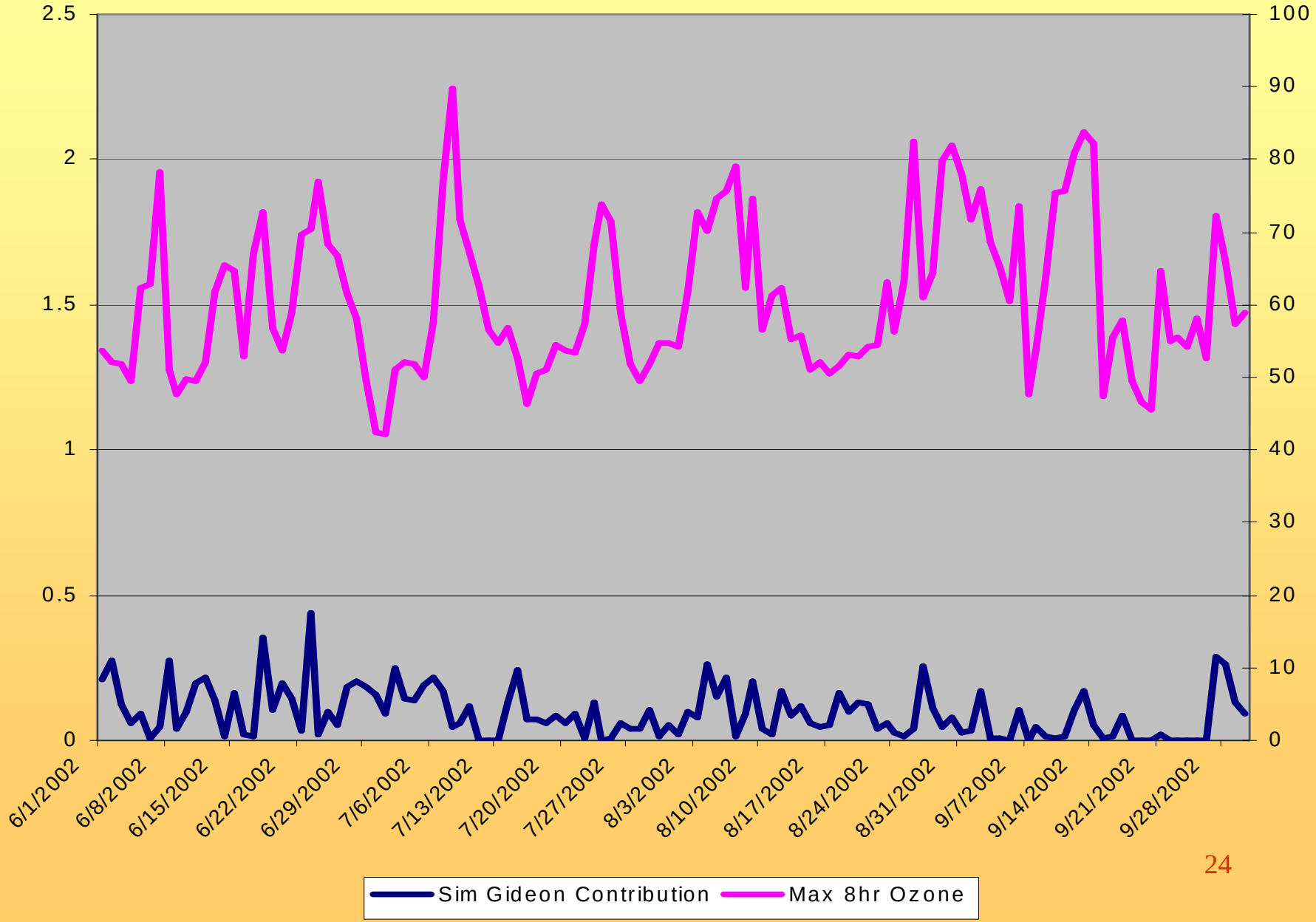
Lehigh Contribution to Max 8hr Ozone (ppb)



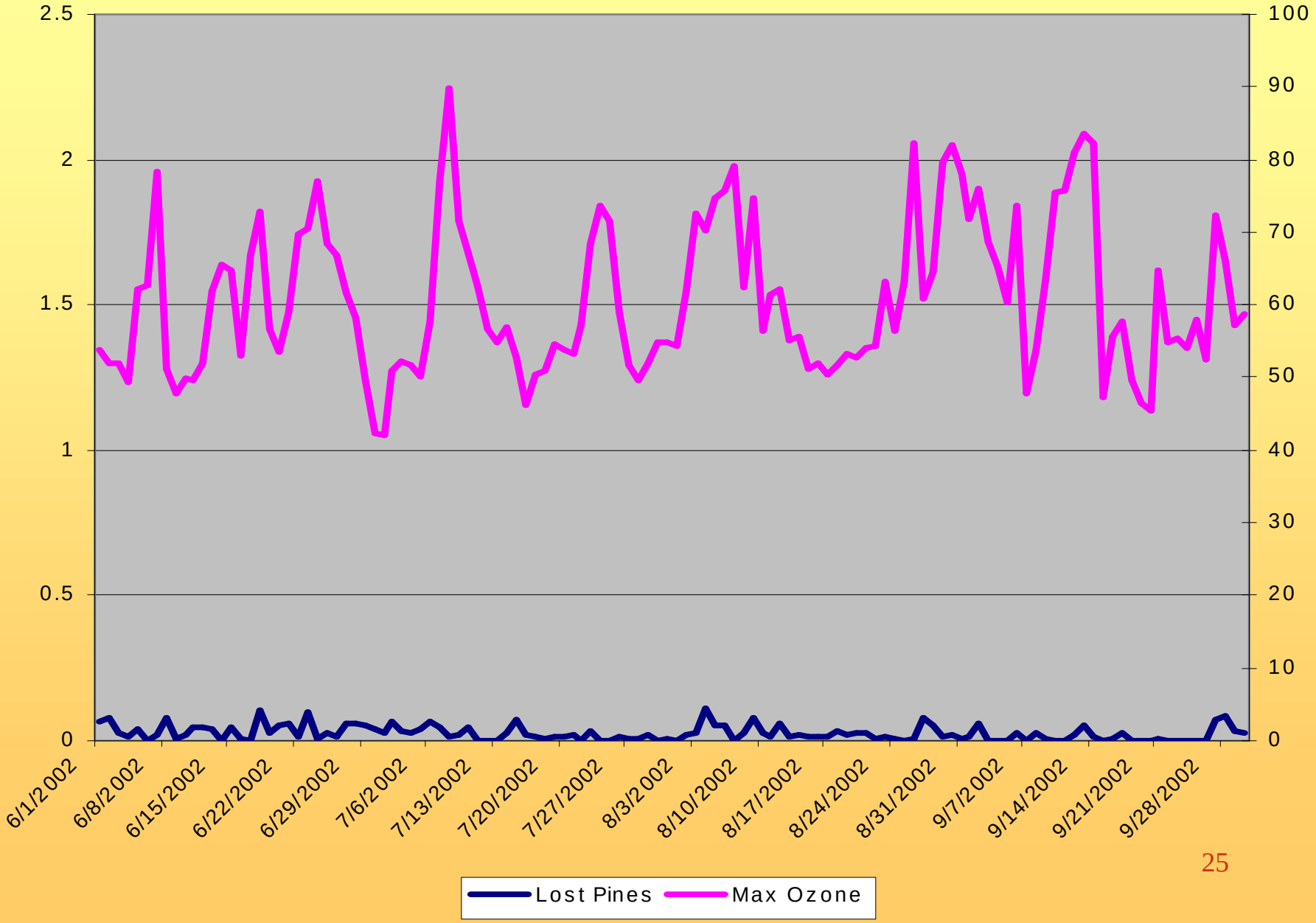
Sand Hill Contribution to 8hr Max Ozone (ppb)



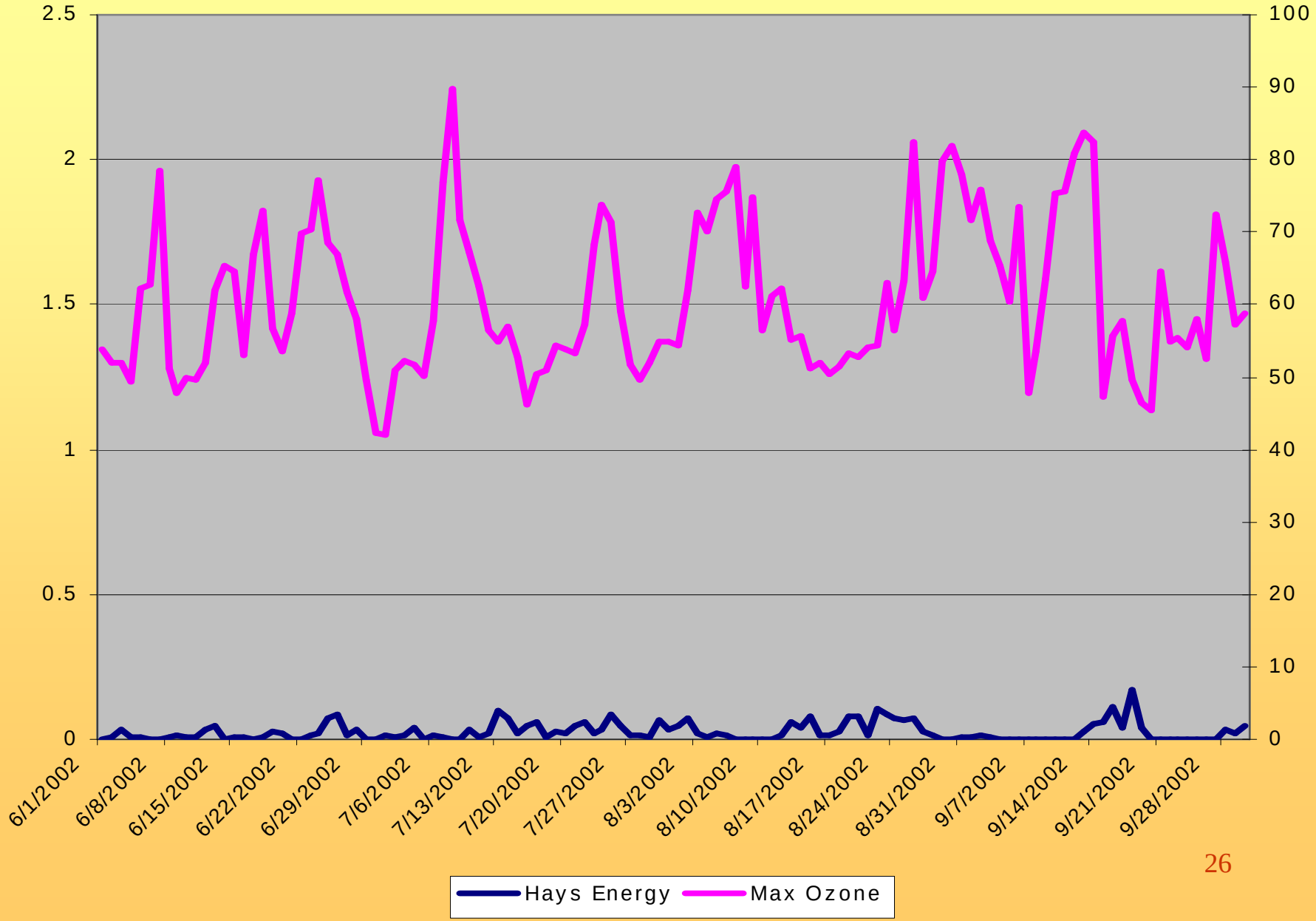
Sim Gideon Contribution to Max 8hr Ozone (ppb)



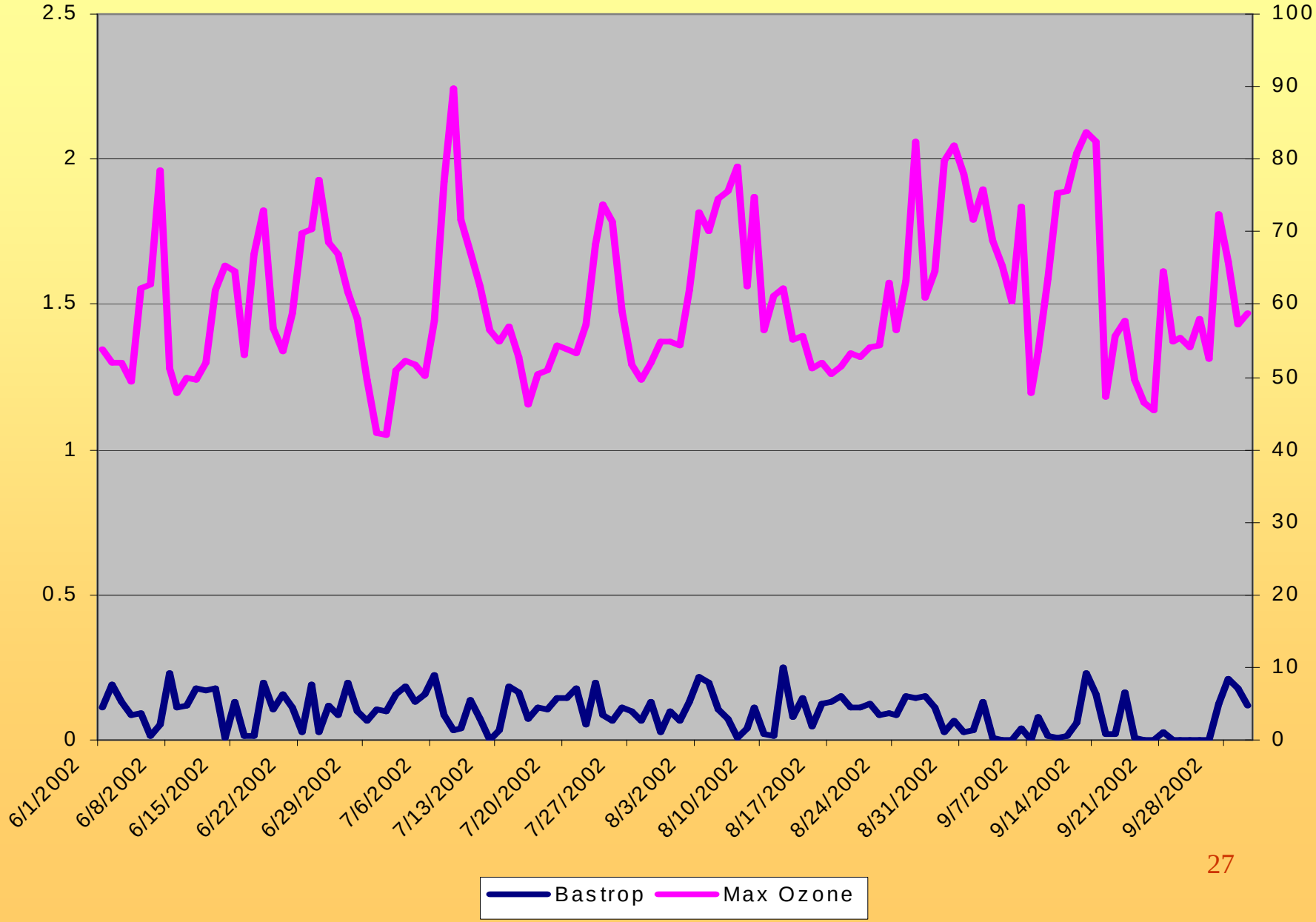
Lost Pines Contribution to Max 8hr Ozone (ppb)



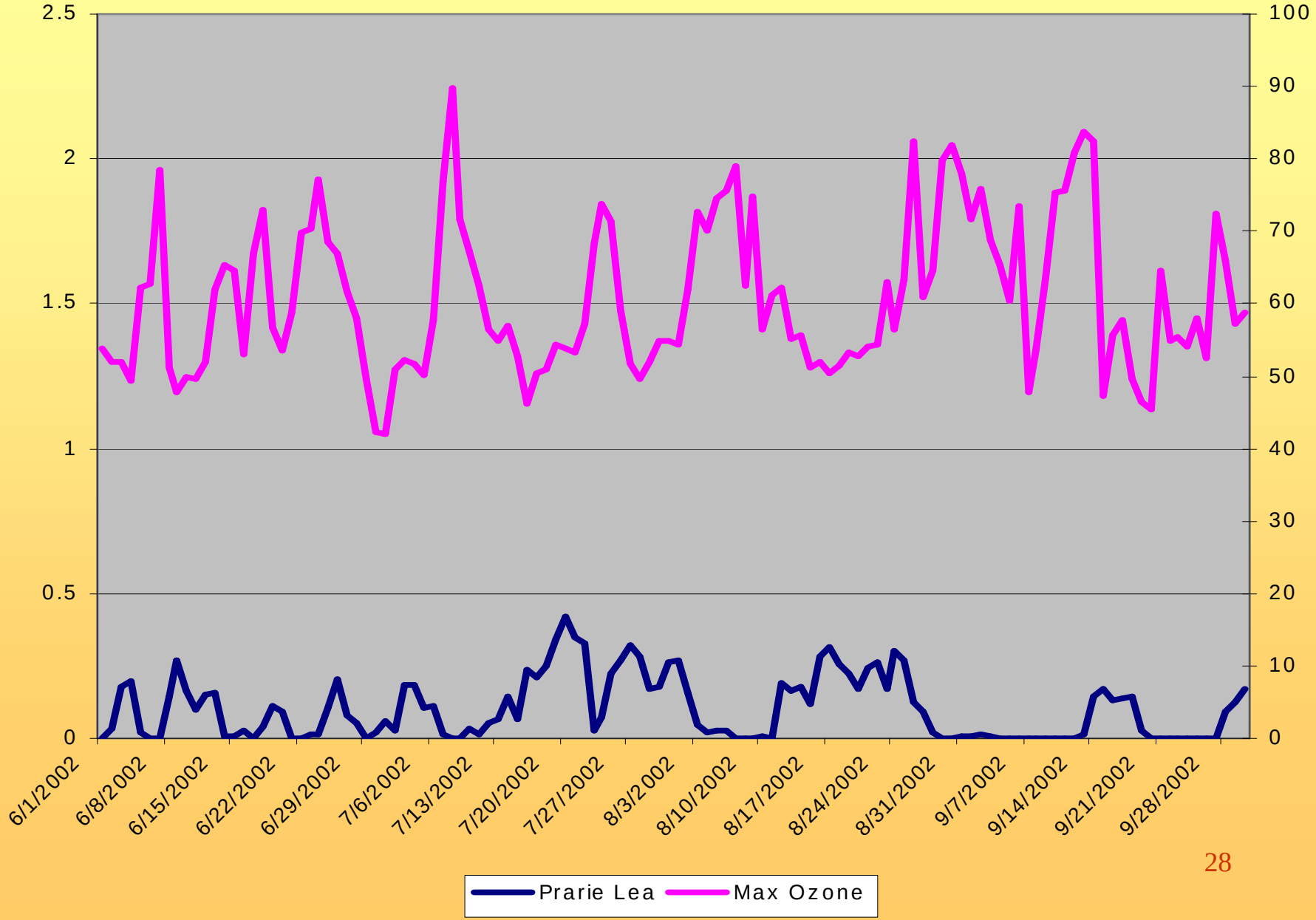
Hays Energy Contribution to Max 8hr Ozone (ppb)



Bastrop Contribution to Max 8hr Ozone (ppb)



Prarie Lea Contribution to Max 8hr Ozone (ppb)



Summary of Average Contributions to Daily Max 8-Hr Ozone All days > 75ppb

Source	Percentage of 12 Source Total Contribution	PPB
Decker	33.2%	1.0
Sandow	20.4%	0.6
Austin Lime	15.8%	0.5
UT	13.2%	0.4
Lehigh	4.9%	0.1
Fayette	3.2%	0.1
Sim Gideon	2.6%	0.1
Bastrop	2.4%	0.1
Sand Hill	2.4%	0.1
Prarie Lea	0.8%	0.0
Lost Pines	0.7%	0.0
Hays Energy	0.4%	0.0

Summary of Average Contributions to Daily Max 8-Hr Ozone at Murchison All days > 65 ppb

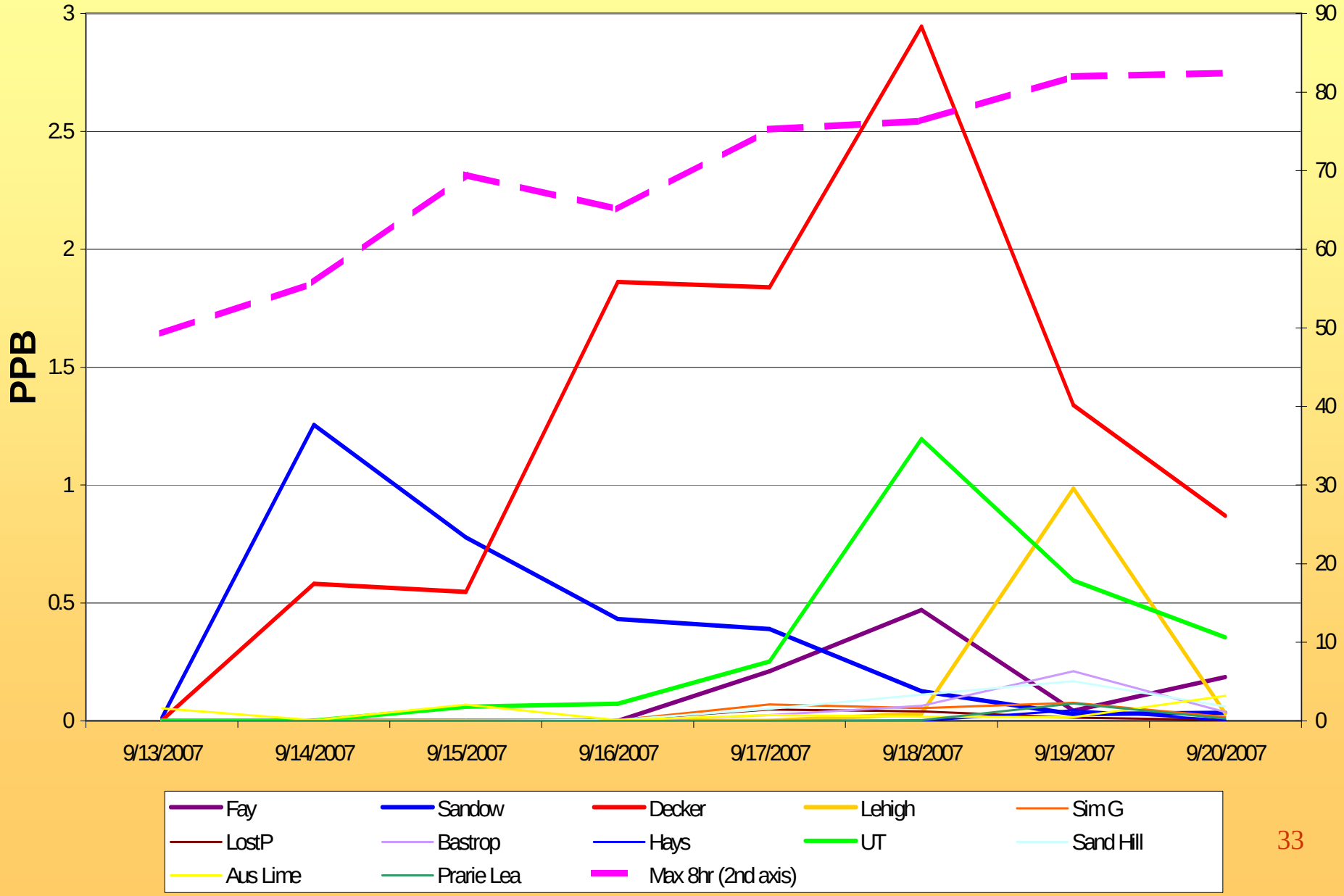
Source	Percentage of 12 Source Total Contribution	PPB
Decker	30.7%	0.89
Sandow	15.5%	0.45
Austin Lime	15.5%	0.45
UT	12.7%	0.37
Fayette	7.0%	0.20
Lehigh	6.8%	0.20
Sim Gideon	3.6%	0.10
Bastrop	3.0%	0.09
Sand Hill	2.3%	0.07
Prarie Lea	1.2%	0.03
Lost Pines	1.0%	0.03
Hays Energy	0.6%	0.02
Total 12-Source Contribution	100.0%	2.90

Summary of Average Contributions to Daily Max 8-Hr Ozone in Entire 5-County Region All days > 65 ppb

Facility Name	ppb O3 Contribution	% of Total 12-Source Contribution
Decker	0.84	29.5%
Sandow	0.43	15.0%
Austin Lime	0.41	14.2%
UT	0.35	12.2%
Lehigh	0.25	8.6%
Fayette	0.24	8.3%
Sim Gideon	0.10	3.5%
Bastrop	0.10	3.5%
Sand Hill	0.07	2.3%
Prarie Lea	0.03	1.1%
Lost Pines	0.03	1.0%
Hays Energy	0.02	0.7%
Total 12 Source Contribution	2.85	100.0%

Early Action Compact Modeling Results

Local Austin Source Contribution to Daily Max 8hr Ozone at Murchison Monitor



Austin Source Contribution EAC Summary of Results

- Contributions reported on this page are averaged for the final four days of the episode (days with daily max 8-hr ozone > 75ppb)
- Average total daily contribution of the 12 sources in the Austin area to maximum 8hr ozone concentrations is 3.3 ppb
- Largest average source contributions: Decker (1.7 ppb)

  Decker will be the focus of Time of Day and Environmental Dispatch Modeling
- Average source contributions > 0.1 ppb: Sandow (0.1 ppb), Lehigh Cement (0.3 ppb), UT (0.6 ppb), Fayette (0.2 ppb)

Austin Source Contribution Air Quality Modeling

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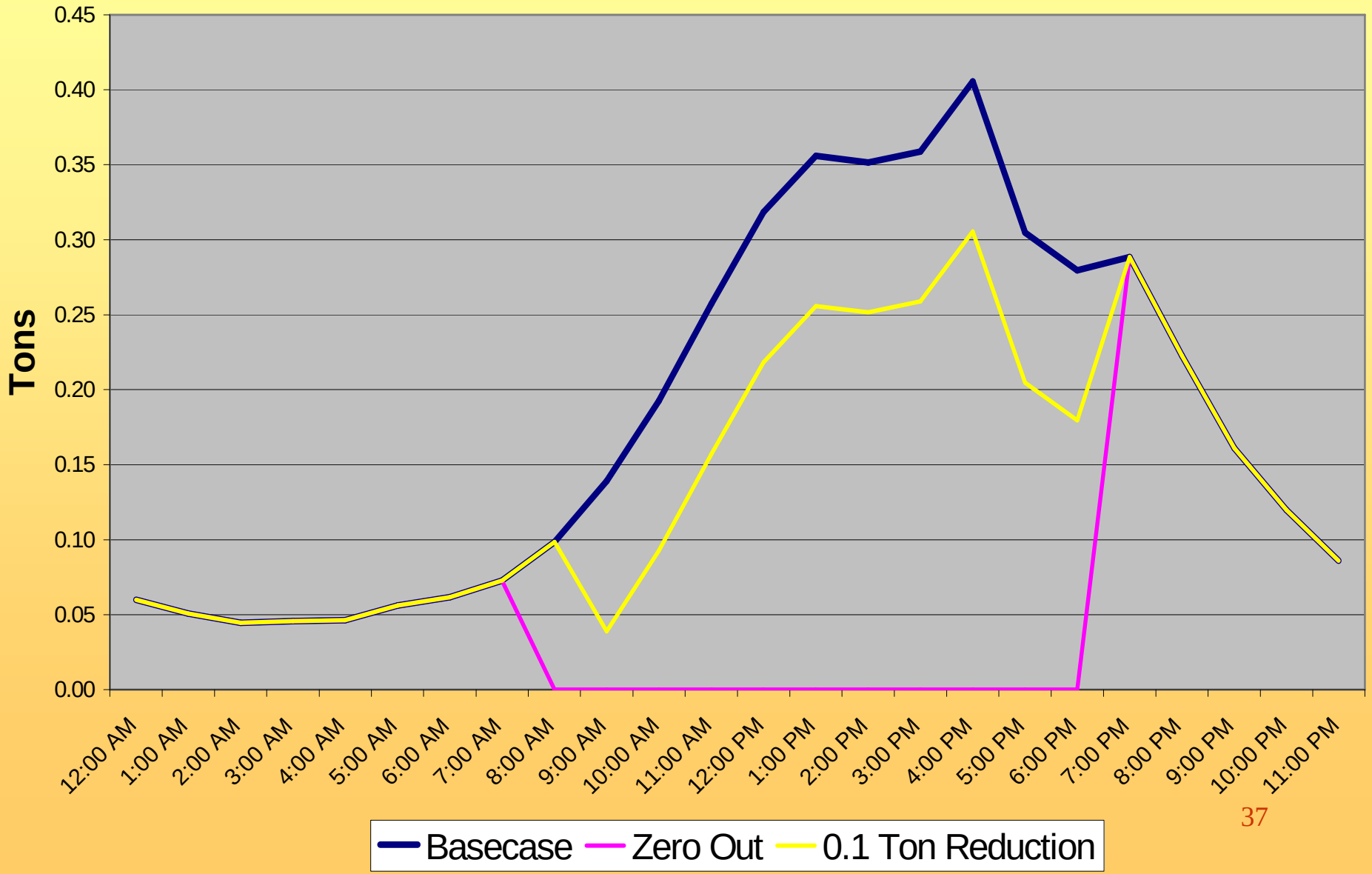
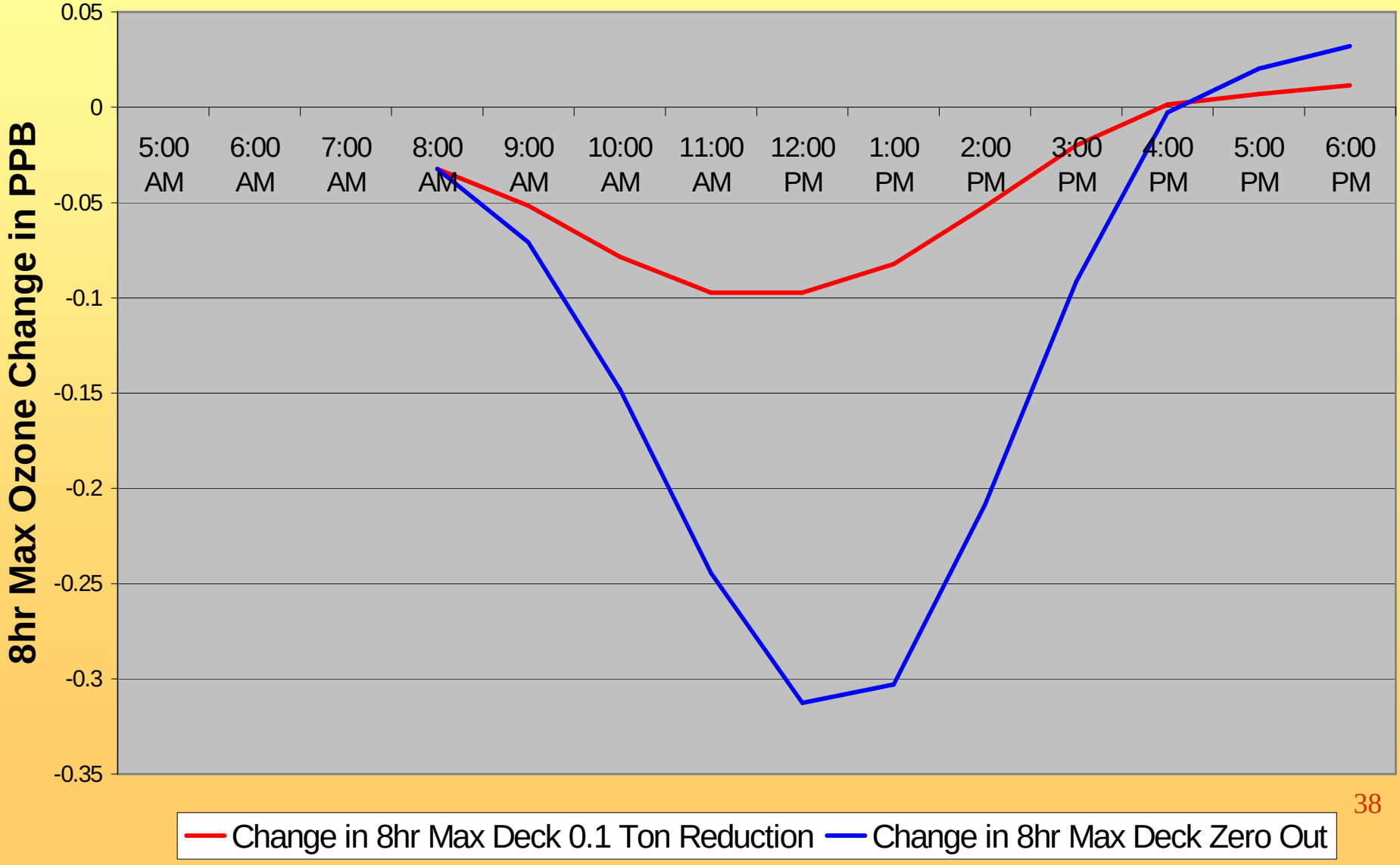
Environmental Dispatch (Step 1) Time of Day Air Quality Modeling

- In order to determine hourly contributions from largest local source: Decker, CAMx (with APCA) was run once for each hour of the day between 8AM and 6PM
- The following changes were made to Decker Emissions for each hour (two different scenarios):
  - Hourly Zero Out
  - 0.1 Ton Hourly Reduction
- 22 individual EAC runs were conducted

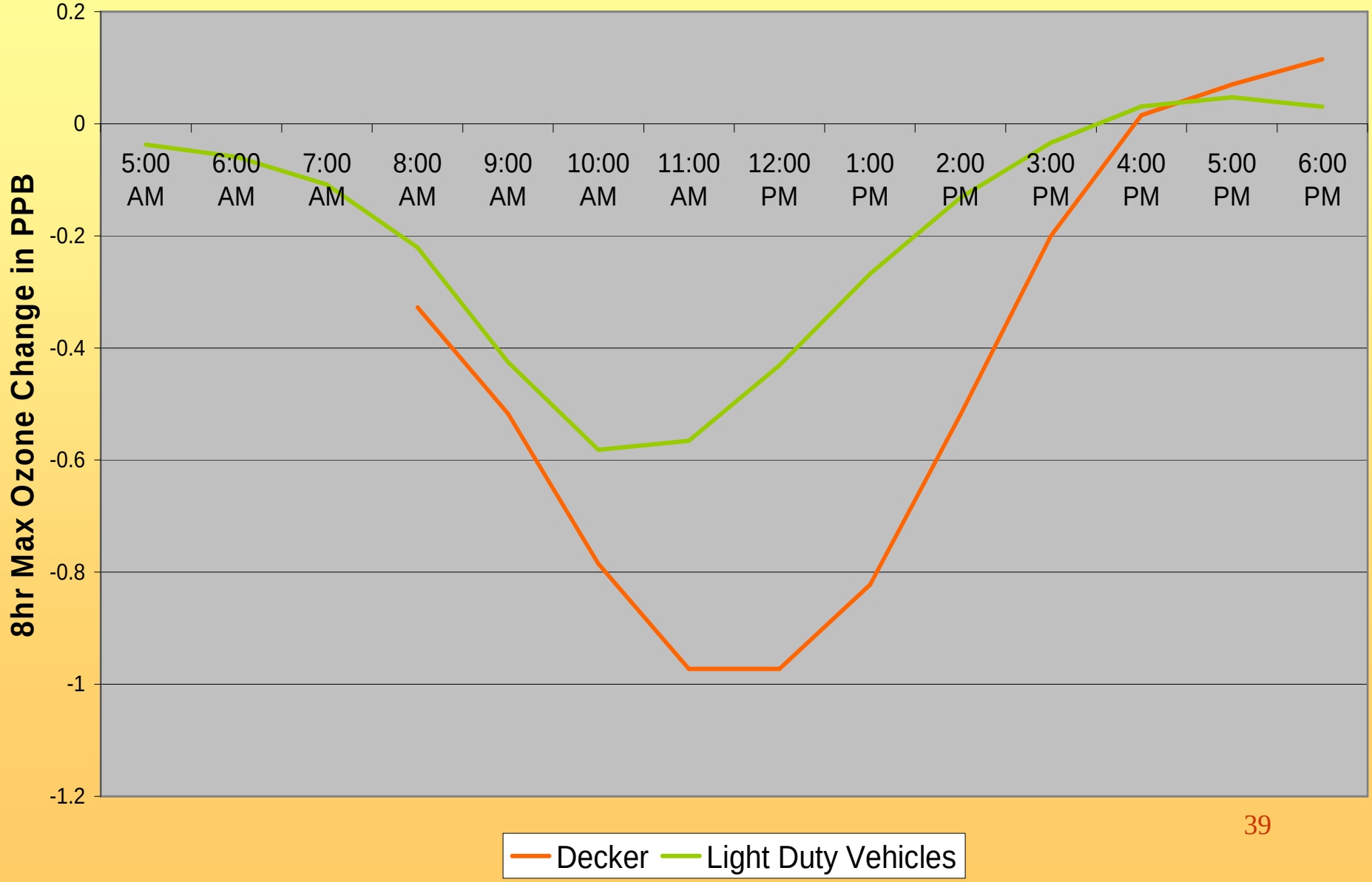
Decker NOx Emissions
EAC Scenarios Diurnal Profile



Change in 8hr Max Ozone due to Decker Hourly Reductions:
Zero Out and 0.1 Ton Reductions
Averaged over Sept. 17th - 20th



Change in 8hr Max Ozone Concentrations per Ton of NOx Reduced at Decker and from Light Duty Vehicles in Travis (Weighted Change)



Environmental Dispatch (Step 1) Summary of Results

- Decker contributes the most to daily maximum ozone concentrations between 9AM and 2PM
  - 11AM and 12PM show the largest contributions at 1ppb reduction in daily max 8hr ozone per ton NOx reduced
  - Reductions made after 4PM have the potential to lead to ozone increases
- Decker contributions are approximately linear (will get the same reduction per ton no matter how large or small the reduction is)
- Decker contributions are additive

Environmental Dispatch (Step 2) Air Quality Modeling

- Using results from Step 1, Austin Energy designed four Environmental Dispatch scenarios with the goal of transferring generation (and emissions) from Decker to Sand Hill during the times of day when emissions from Decker are most likely to lead to ozone.
- CAMx was used to model these scenarios to evaluate the effectiveness.
- Ozone was reduced by up to 1.2 ppb, making Environmental Dispatch a worthwhile effort

Questions?