Weekday-Weekend Emissions Patterns in Southern California: Observations and Implications

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Presented at the
NARSTO Workshop on Innovative Methods for
Emission-Inventory Development and Evaluation
University of Texas at Austin
October 14-17, 2003

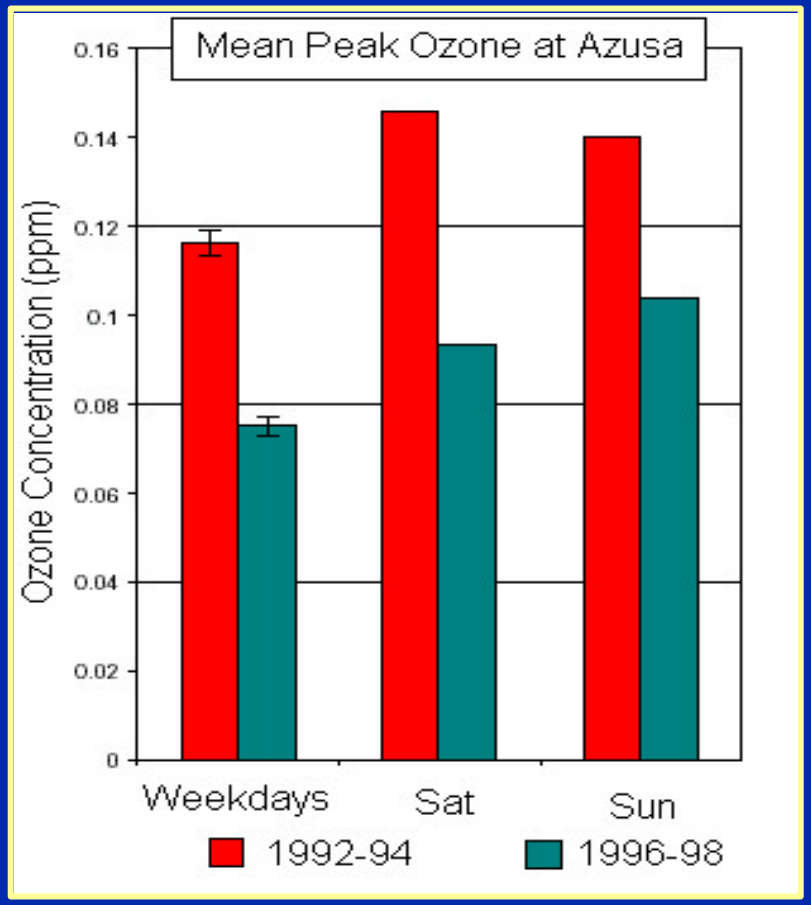
Weekend Effect in Los Angeles

Los Angeles ozone air quality generally improved over the past decade.

- No. of 1-hr exceedances decreased from about 150 to only 50 per yr from 1980 to 1999.

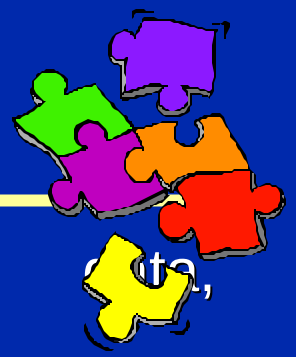
Weekend (WE) peaks = weekday (WD) peaks.

- From 1980-1999, WD-WE difference became more pronounced.
- How can this be if WE precursor emissions are lower?



Source of figure: Austin, J.; Tran, H. "A Characterization of the Weekend-Weekday Behavior of Ambient Ozone Concentrations in California"; Draft staff report prepared by the Technical Support and Planning Division, California Air Resources Board, Sacramento, CA. 1999.

Purpose and Objectives



Purpose: Address a lack of WE-specific emissions data, which are needed to support air quality modeling exercises for WE conditions in Los Angeles.

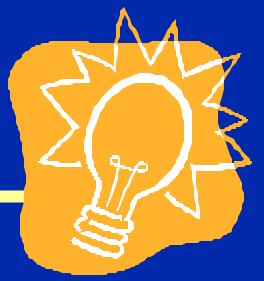
Objectives:

Characterize WD-WE activity patterns for selected types of emissions sources in Los Angeles.

Coordinate concurrent data collection efforts

- Telephone and mail surveys (residences, small businesses)
- In-vehicle travel activity measurements
- Monitoring of traffic volumes on surface streets
- Acquisition of freeway-based traffic volumes
- Acquisition of continuous emissions monitoring systems (CEMS) data for major stationary point sources

Innovative Approaches



Track many vehicles for many days by using low-maintenance global positioning systems (GPS)*.

- Trade off some complexity and detail in the collected data (e.g., no key-on/key-off data).
- Greatly increase sample size and longitudinality: 105 vehicles, >1200 vehicle-days, and >6000 trips.

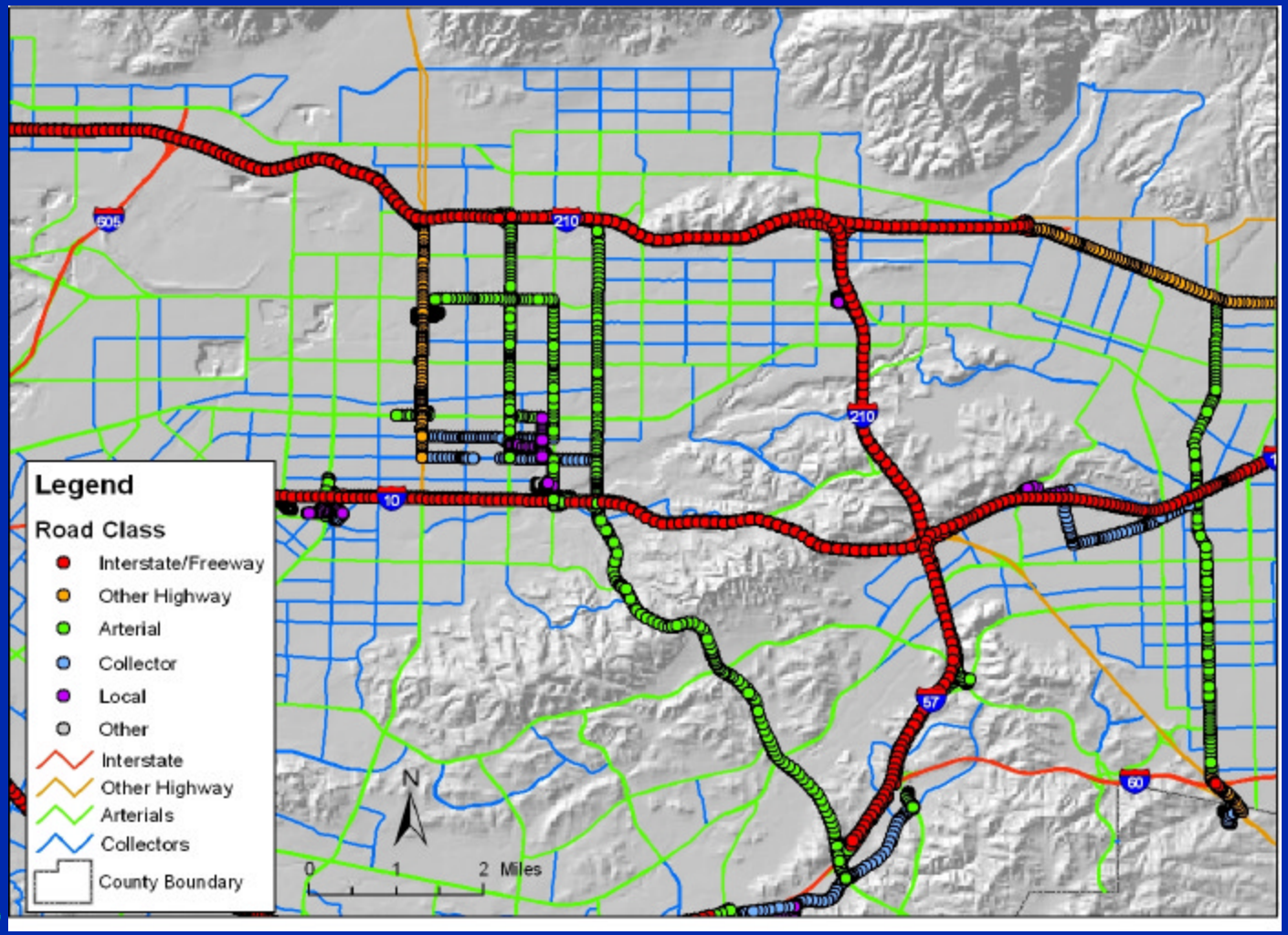
Use recently available GPS-accurate streets databases to facilitate data analyses in a geographic information system (GIS).

- Support automated GIS processing of large data sets.
- Support analyses according to road class.

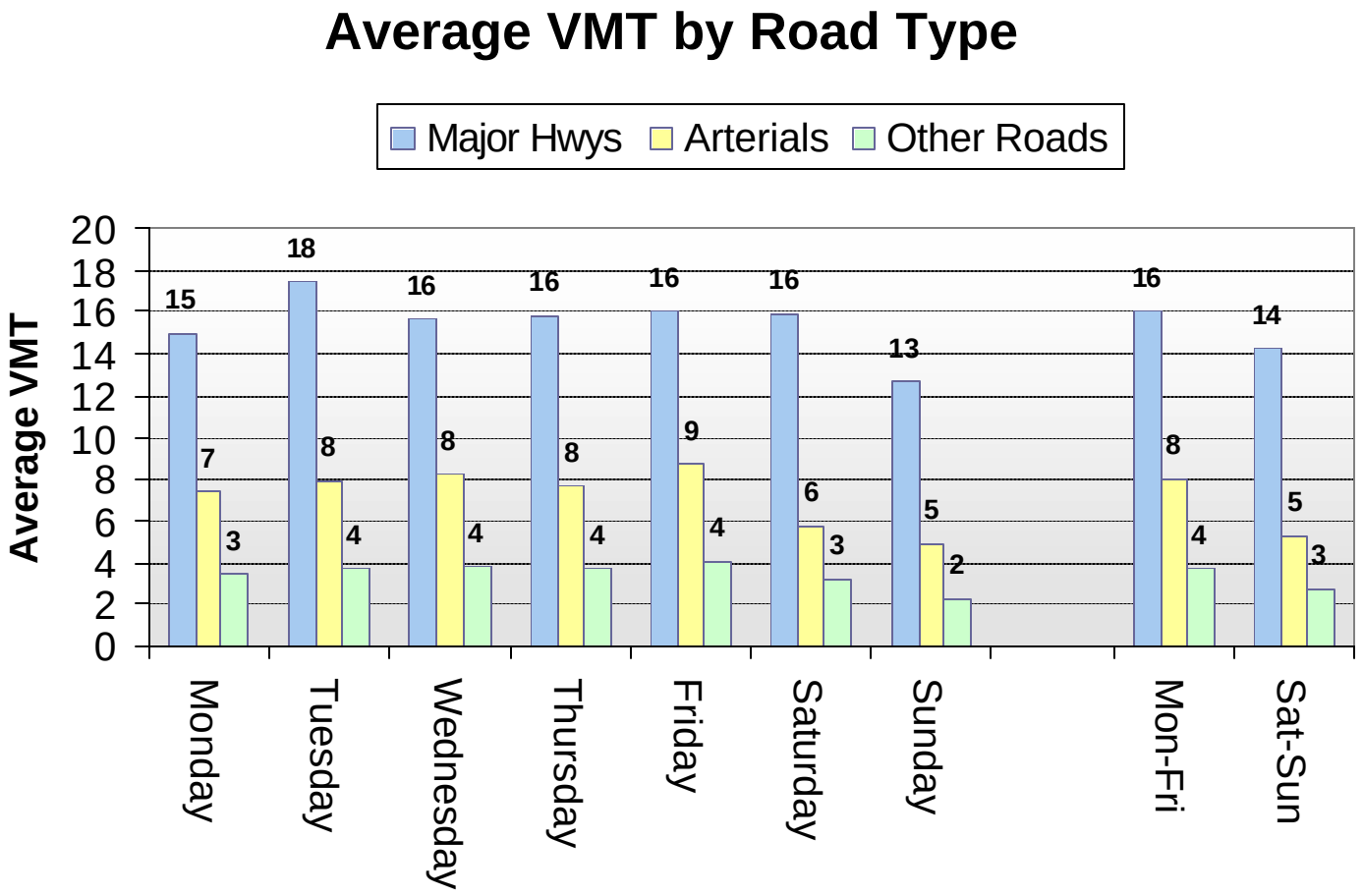
*The Geostats' GeoLogger

GPS Logger and Recruits

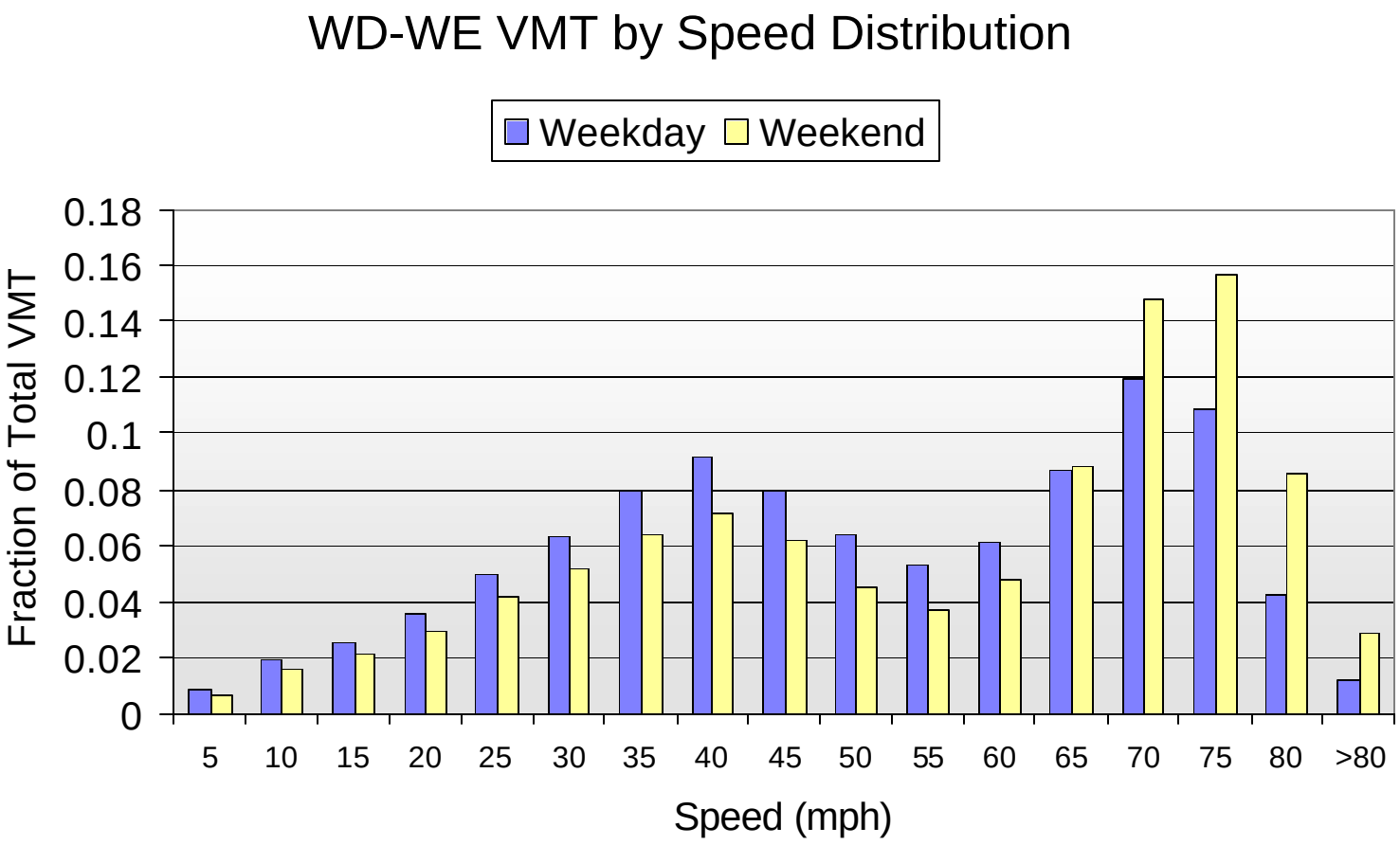
GPS-Accurate Road Networks



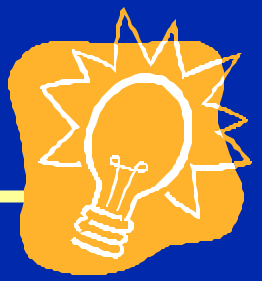
Results: VMT by Road Type



Results: Speed Distribution



Innovative Approaches

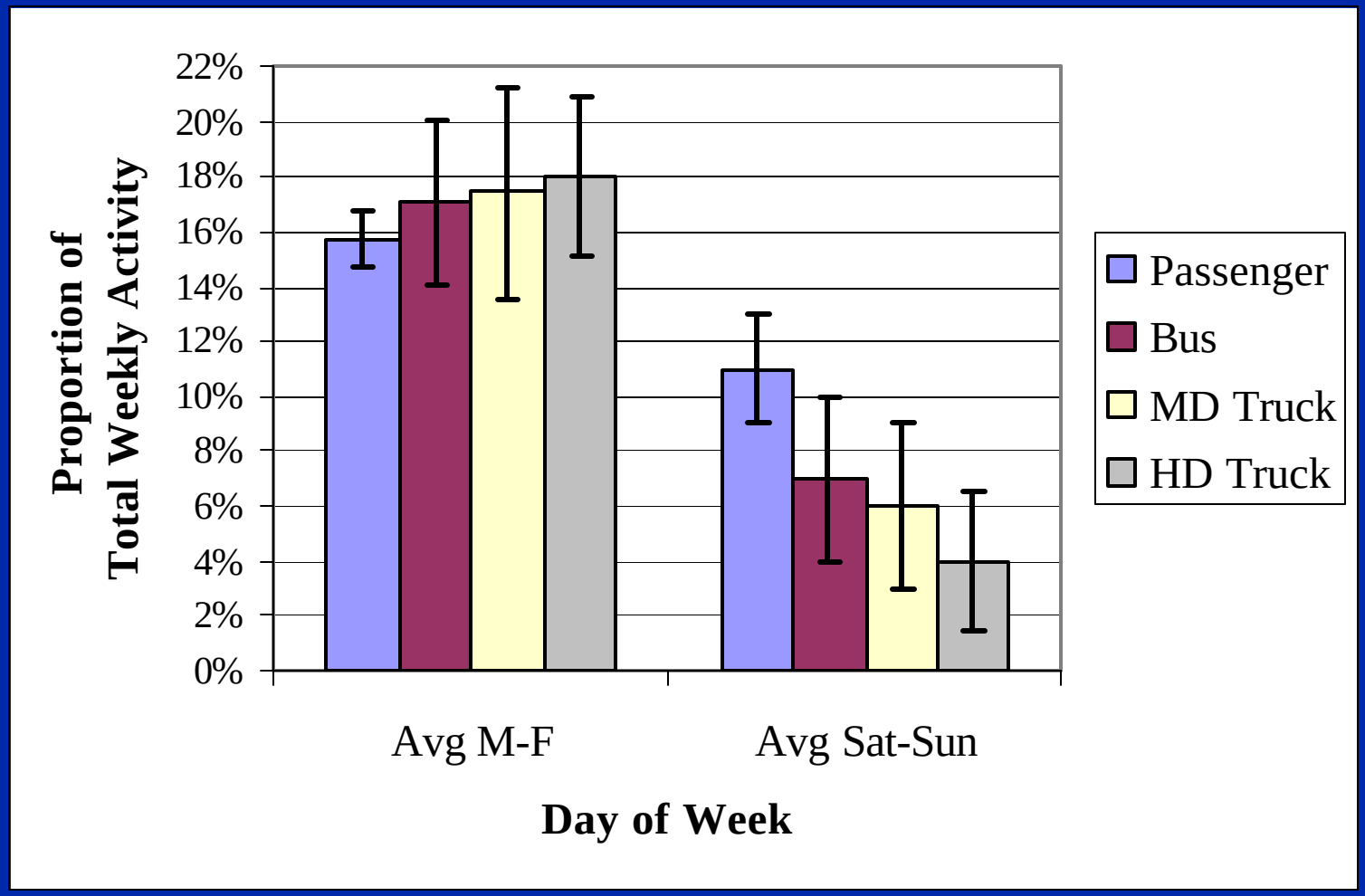


Use standard methods in new ways or for new purposes.

- Collect traffic count data at sites selected to represent specific land use patterns, trip origins, and trip attractions.
- Collect daily activity diaries for many days (longitudinal study).
- Use continuous emissions monitoring systems (CEMS) data to study WD-WE patterns.

Traffic Counter Locations

Results: Relative WD-WE Activity by Vehicle Type



10-Day Daily Activity Diaries

CARD 2 **DAILY ACTIVITY SURVEY FOR: SATURDAY**

1. Was a barbeque grill used at your household today? YES NO
   When? (check all that apply) ☐ Morning ☐ Afternoon ☐ Evening ☐ *Total minutes used?*

2. Please check if items were used at your household today, and indicate when they were used:

☐ Paints, varnishes, stains, thinners, solvents, or degreasers	☐ Morning ☐ Afternoon ☐ Evening
☐ Consumer products (hair sprays, dyes, nail polishes, polish removers)	☐ Morning ☐ Afternoon ☐ Evening
☐ Took a shower or bath (with warm or hot water)	☐ Morning ☐ Afternoon ☐ Evening
☐ Clothes washer or automatic dishwasher (using warm or hot water)	☐ Morning ☐ Afternoon ☐ Evening

3. How many times did a passenger vehicle depart from your household today? 0 1 2 3 4 5 More than 5 times
   When? (check all that apply): ☐ Morning ☐ Afternoon ☐ Evening

4. How many times did you start a vehicle at your household without driving it today? 0 1 2 3 4 5 More than 5 times

5. Did any household member use a recreational watercraft today (such as a boat, jet ski, or other)? YES NO
   When? (check all that apply) ☐ Morning ☐ Afternoon ☐ Evening ☐ *Total hours used?*

6. Did any household member use an off-road recreational vehicle (such as an ATV, dirt bike, or 4-wheel drive)? YES NO
   When? (check all that apply) ☐ Morning ☐ Afternoon ☐ Evening ☐ *Total hours used?*

7. Did you consider today a ☐ Work day ☐ Holiday/vacation day off ☐ Regular day off (Please check one)

8. Your answers to the questions above apply to **SATURDAY** *on what date?* _____

9. Are you completing this card *on the same date* that you just entered on line 8 above? YES NO

10. If NO, what date did you complete this postcard?_____

THANK YOU. Please drop this post card into any mailbox.

Results: Summary

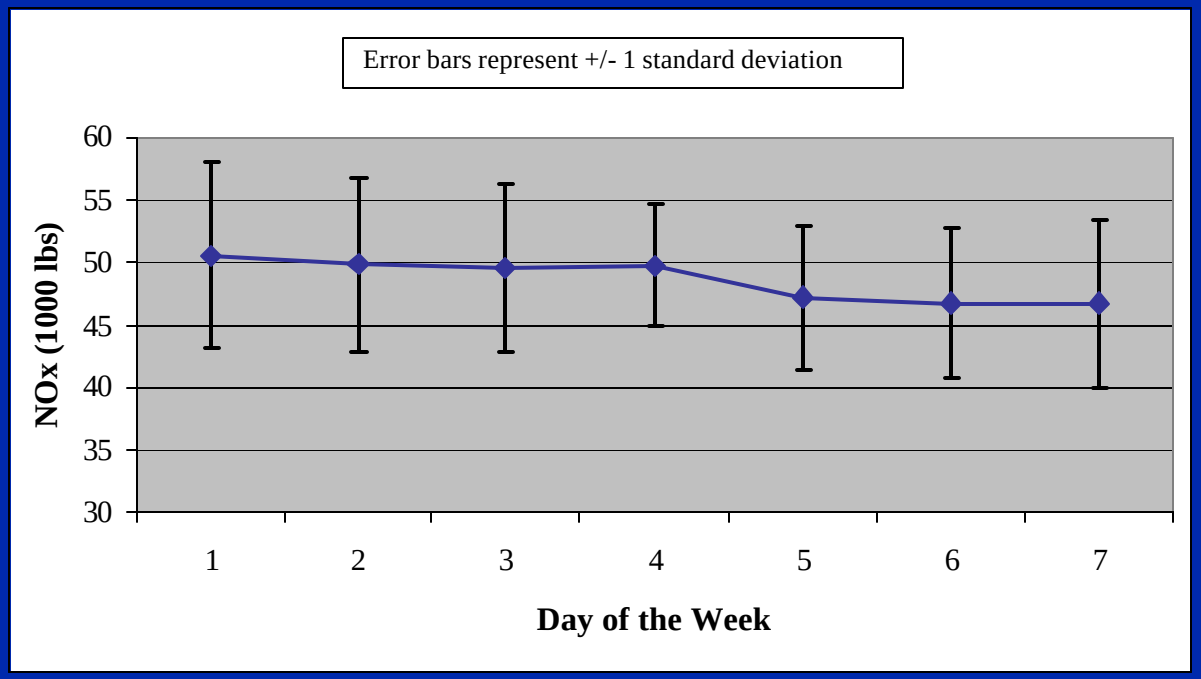
Some residential activities (RAs) in Los Angeles increase from WD to WE by 25% to 165% (e.g., BBQs, recreational boats, recreational RVs).

Other RAs vary little by day of week (DOW) (e.g., personal care products, water heating).

Diurnal distributions of some RAs vary by DOW.

- On WDs, BBQ use occurs primarily in the evening, but on WEs the afternoon share of use increases significantly.

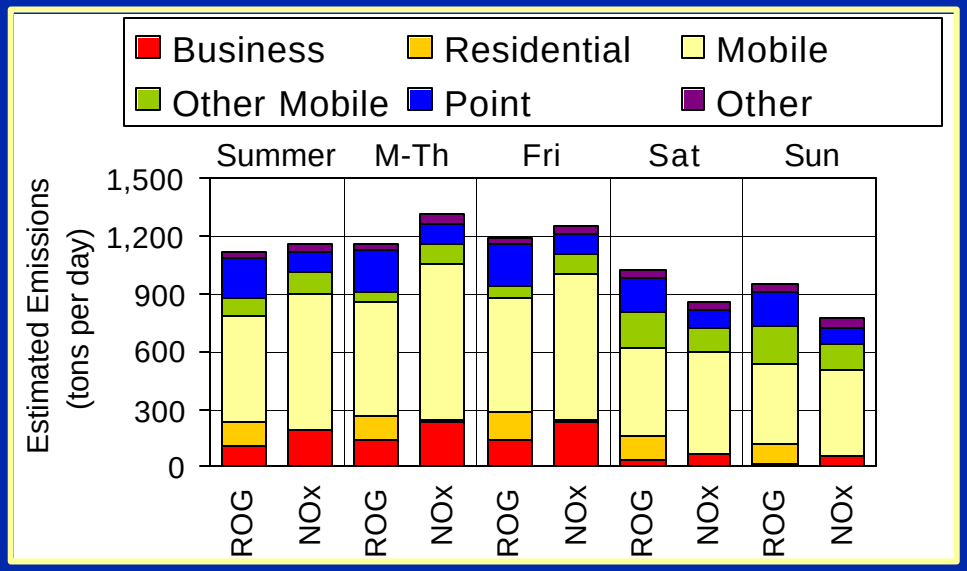
CEMS Data and Findings



- On average, NO_x emissions decline 5% on weekends during the summer.
- Smaller point sources tend to have greater WD-WE variability than larger point sources.

Integration and Implications (1 of 3)

WD-WE Emissions: Year 2000



What effects would be expected?

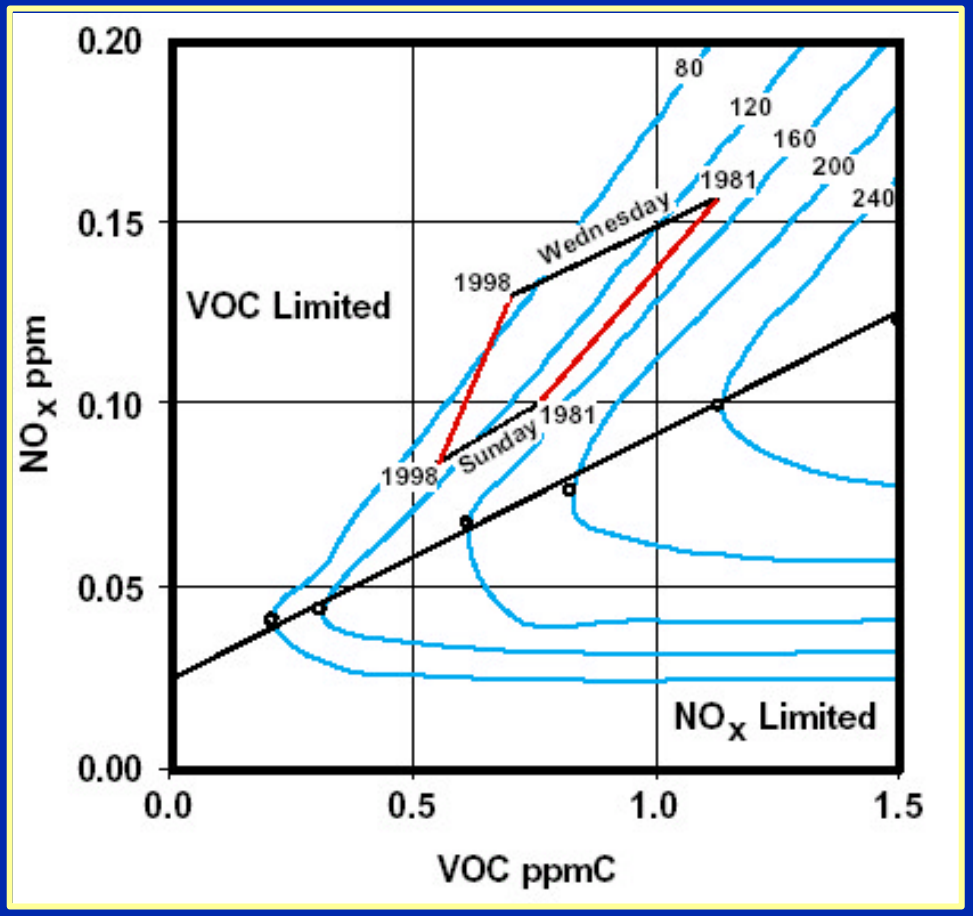
- Reduced ROG and NO_x emissions**
- Increased ROG:NO_x ratio**
- Decreased morning O_3 titration capacity by NO_x

**to an even greater extent than the preliminary results shown above.

Integration and Implications (2 of 3)

What effects would be expected?

- WE conditions are more favorable for O_3 formation than WD conditions.



Source of figure: Fujita, E.M., et al. "Weekend/Weekday Ozone Observations in the South Coast Air Basin: Retrospective Analysis of Ambient and Emissions Data And Refinement of Hypotheses, Volume I – Executive Summary"; Final report prepared for the National Renewable Energy Laboratory, December 2000.

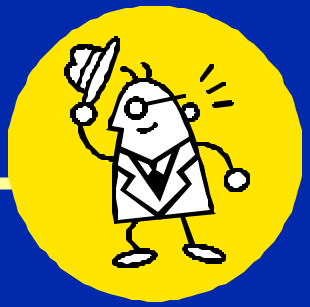
Integration and Implications (3 of 3)

Researchers are arriving at similar conclusions for other cities and areas, though not everyone agrees.

- Cities throughout California (Marr and Harley, 2002)
- Areas of the United Kingdom (Jenkin, Davies, and Stedman, 2002)
- Baltimore, Maryland (Vukovich, 2000)
- Tucson, Arizona (Diem, 2000)

- Raleigh, North Carolina (Aneja, Kim, and Chameides, 1997)
- Los Angeles (Croes, Dolislager, Larsen, and Pitts, 2003).

Acknowledgments



California Air Resources Board (ARB) – Financial support and contract management

Mr. Leon Dolislager, ARB – Technical Advisor and ARB Project Officer

Wiltec (Pasadena) – Provider of surface street traffic counters

GeoStats (Atlanta) – Supplier of GeoLoggers and data processing services

Population Research Systems (San Francisco) – Implementation of telephone and mail surveys

South Coast Air Quality Management District – Provider of CEMS data