

**A Study to Evaluate the Health Effects of Air
Pollution in Bexar County with a Focus on Local
Coal and Gas Fired Power Plants**

Scott Smith

Director

Environmental Planning & Compliance

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Board of Trustees Commitment

- Board of Trustees announced CPS Energy's commitments on Health Effects to the citizens of San Antonio on June 30, 2003
- These commitments included:
 - Install Best Available Control Technology (BACT) to reduce emissions on any new source and upgrade existing coal sources to reduce emissions.
 - Monitor ambient air quality around Calaveras Lake.
 - Conduct an independent study detailing health implications of power plants.



Board of Trustees Commitment

- Environmental Health Oversight Committee
 - Conduct an independent study detailing health implications of power plants.
 - Conduct a third-party air performance audit of Calaveras Power Station's environmental controls and systems.



BACT and Upgrades

- CPS Energy is in the process of installing Best Available Control Technology (BACT) on the new JK Spruce 2 unit, which is one of the cleanest coal plants in the country.
- Costs spent on BACT for JK Spruce is close to \$260 million.
- CPS Energy has modified and will continue to modify existing coal units with aggressive emissions reduction technologies. Previous expenditures amount to \$181 million.



Air Monitoring Program

- CPS Energy installed continuous air monitoring systems (CAMS) around Calaveras Lake and surrounding areas.
- Data available for viewing on the TCEQ website.
- CAMS reports are available for public viewing at nearby schools and city libraries.



3rd Party Air Audit

- The third-party air quality compliance performance audit was conducted in 2004-06. The audit primarily focused on reviewing records and reports.
- Overall results of the audit were positive.
- The audit had three minor findings, all of which were corrected immediately.



Health Study

- Contracted Dr. Jimmy Perkins from the University of Texas School of Public Health at Houston, San Antonio Regional campus.
- Used most recent health effects data available, newest state-of-the-art dispersion models and most currently available emissions data for all sources in the U.S.

A Study to Evaluate the Health Effects of Air Pollution in Bexar County with a Focus on Local Coal and Gas Fired Power Plants

Jimmy Perkins, PhD

Lynne Heilbrun, MPH

Elaine Symanski, PhD

Ann Coker, PhD

Kathryn Eggleston, MPH

University of Texas School of Public Health

San Antonio and Houston campuses

Key Findings

- Of the various emissions attributable to power plants, particulate matter (PM) has the most significant health impacts
- CPS Energy's direct and indirect emissions of PM account for only 1.2 % of San Antonio's total exposure; remainder of emissions attributable to other sources such as vehicular traffic
- PM concentrations due to CPS Energy sources are one hundred times smaller than the EPA standards
- CPS Energy may account for 0.2% of the community's health effects attributed to PM



Key Findings (cont.)

- CPS Energy power plant sources cause the ambient long-term ozone levels (annual) to decrease in Bexar County, because nitric oxide (NO) emitted from the plants acts as a scavenger
- Very little of the mercury contained in fish from Braunig and Calaveras Lakes comes from CPS Energy emissions, and the slight mercury levels in the fish from the lakes are at levels significantly lower than commercially available sea food and; therefore, the fish are quite safe to eat

Health Study Components

- Results of epidemiological studies
- Exposure data
- Incidence of mortality and morbidity in Bexar County
- Census tract populations



Epidemiological Studies

- Relate air pollution exposure to either
 - Morbidity... usually hospital admissions
 - Mortality
- Look at health effects of exposure over
 - Short term (days)
 - Or long term (years)



Epidemiological Studies

- Effect estimates
 - For example, Sheppard (1999) reports
 - Each additional 1 ppb exposure to ozone increases the risk of asthma related hospital admission by 0.3 %.
 - So roughly if the concentration is increased by 10 ppb, hospital admissions are expected to increase by $10 \times 0.3 = 3$ %.



Criteria used to select studies for estimation of health effects

- Study relied on in last EPA Criteria Document (CD) or published subsequent to last CD (usually post 1995)
- Study site in SW US or multi city study
- Significant + results
- Multi pollutant models not used
- Averaging time (AT) and lag time (LT) with highest conservative effect estimate chosen

Exposure Data

- Continuous air monitoring stations (CAMS)
 - Limited coverage
 - E.g. only two stations measured PM_{2.5} prior to 2004 in Bexar County
 - Non identifiable
 - E.g. a reading at one CAMS of 76 ppb ozone does not tell us who is responsible for that ozone
 - Cars?
 - Cement plants?
 - Construction equipment?
 - CPS Energy?



Comprehensive Air Quality Model with Extensions (CAMx)

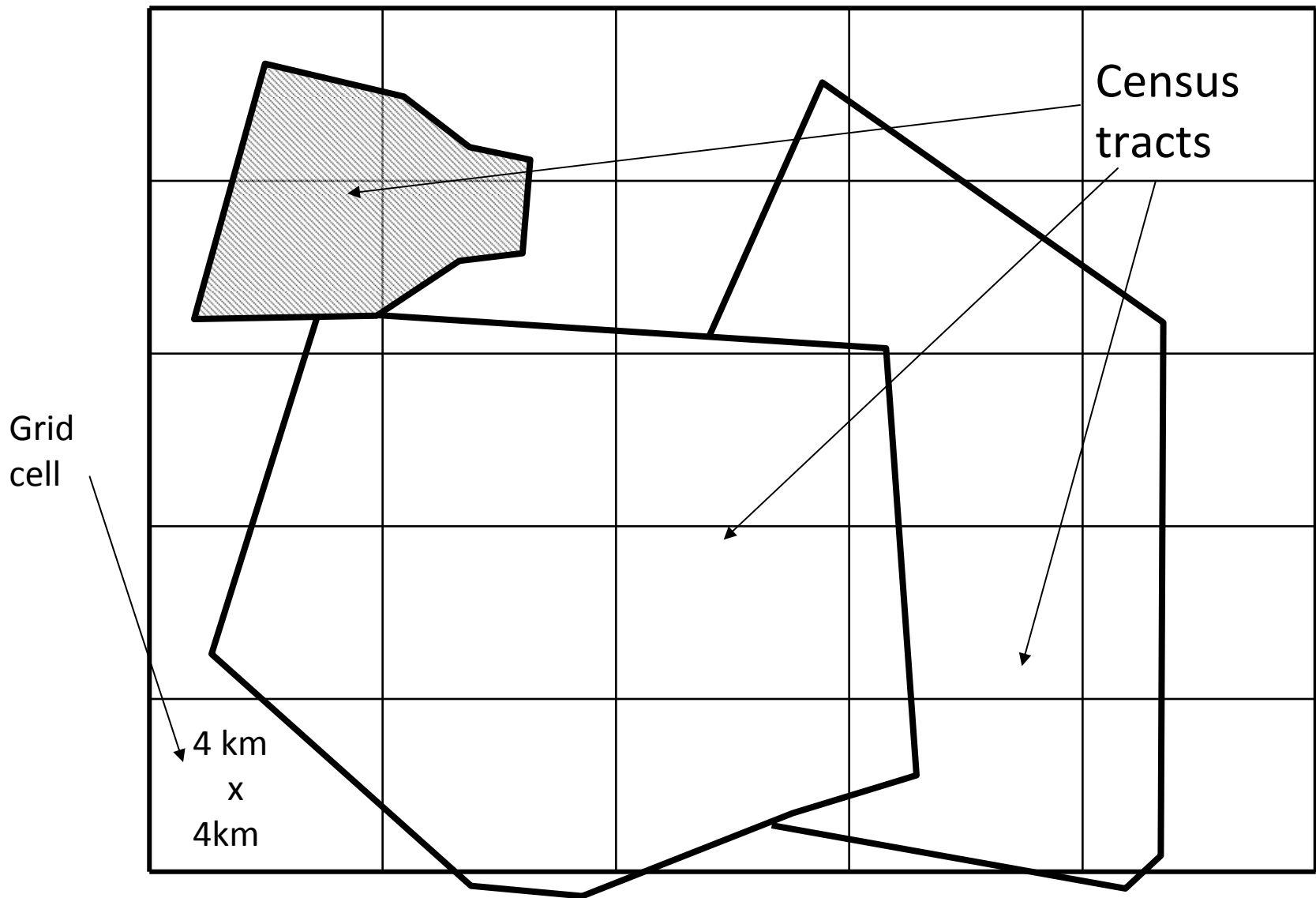
- Alpine Geophysics
- In each grid cell, pollutants are
 - emitted
 - transported from cell to cell
 - diffused by turbulence
 - undergo chemical reactions
 - removed by precipitation, ground adsorption, and other means



CAMx Requirements

- Detailed meteorological data
 - Only 2002 available
- Emissions data from throughout North America on a space and time basis
 - 2002 based on actual emissions
 - 2009 based on estimates and projections





Twenty five grid cells overlain on 3 complete census tracts showing that four grid cells contribute to the average concentration in the shaded grid cell.

CAMx Outputs

Pollutant	Averaging times			
	1-hr	8-hr	24-hr	Annual
PM ₁₀			X	X
PM _{2.5}			X	X
PM _{coarse}			X	X
Ozone	X	X	X	
CO	X	X	X	
SO ₂			X	X
NOx				X
Mercury, Hg				X
Hg-Deposition				X

Scenarios Studied

- Past, approximately 1997
- Current, approximately 2002
- Future, approximately 2013



Averaged daily modeled air pollution concentrations (units in last column) attributable to ***CPS Energy emissions***; averaged over year and across Bexar County

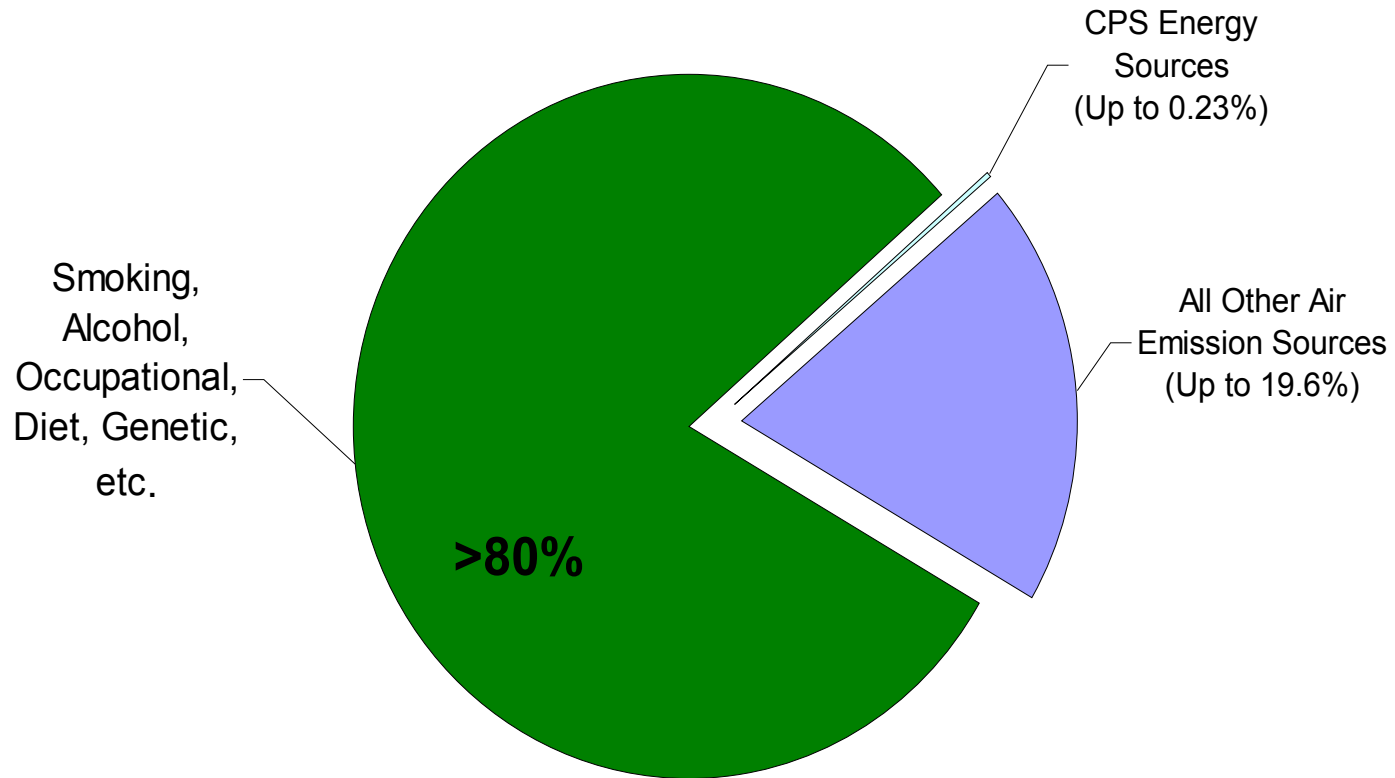
Pollutant-AT	1997	2002	2013	EPA NAAQS
CO-1 hr	0	0	0.00032	35 ppm
CO-8 hr	0.00010	0	0.0004	9 ppm
CO-24 hr	0.00011	0.0001	0.0004	-
O ₃ -1 hr	-0.22	0.02	0.09	124 ppb
O ₃ -8 hr	-0.45	-0.13	-0.08	79 ppb
O ₃ -24 hr	-0.42	-0.16	-0.17	-
NO _x -24 hr	0.000604	0.0003	0.000283	0.053 ppm
SO ₂ -24 hr	0	0.0003	0.00023	0.14 ppm
PM ₁₀ -24 hr	0.19	0.2	0.24	150 µg/m ³
PM _{2.5} -24 hr	0.15	0.16	0.19	15 µg/m ³
PM _{Coarse} -24 hr	0.04	0.05	0.05	-

Incidence of all cause (non-accidental, ICD-9 <800) mortality in Bexar County, potentially attributable to CPS Energy and all sources of pollution, as a percent of the total deaths in the county from all causes for 2002

Pollutant	n	CPS ¹	All sources	Total deaths	Age
<i>Short term (day or less exposure) estimates</i>					
CO	3	0.00-0.01%	0.1-0.56%	9025	All
O ₃	3	0.00%	0.03-0.14%	9025	All
PM ₁₀	4	0.00-0.03%	0.67-4.05%	9025	All
PM _{2.5}	3	0.02-0.05%	1.6-4.22%	9025	All
<i>Long term (yearly exposure) estimates</i>					
PM _{2.5}		0.09%	7.70%	8675	30+
PM _{2.5}		0.23%	19.6%	8675	25+

¹ 0.00 means less than 0.01%

Long Term Health Effects Estimates attributable to PM_{2.5} for Bexar County¹



1 - Based on Harvard Six Cities Study (Laden et al. 2006).



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HEALTH SCIENCE CENTER AT HOUSTON

Incidence of long term exposure related mortalities in Bexar County, potentially attributable to CPS Energy and all sources of pollution, as a percent of total deaths from various causes 2002

Pollutant	Disease	CPS	All sources	Total deaths	Age
PM _{2.5}	CV	0.21%	17.4%	2813	25+
PM _{2.5}	Lung Can	0.21- 0.38%	17.3- 21.7%	610	25+



Incidence of asthma hospital admissions in persons <65 in Bexar County, potentially attributable to CPS and all sources of pollution, as a percent of the estimated 1200 asthma hospital admissions for 2002.

Pollutant	CPS	All Sources
CO	0.01%	1.62%
O ₃	0.00%	4.65%
PM ₁₀	0.04%	4.59%
PM _{2.5}	0.05%	5.65%



PM

- Particulate matter (PM) is very important
- It is a mix of carbon, hydrocarbons (like solvents or gasoline), metals, dirt, and sulfates, and nitrates
- These come from various sources like fires, dirt roads, construction activities, cars, and power plants
- These are not equally toxic
- CAMS do not tell us anything about PM except the weight ($\mu\text{g}/\text{m}^3$)

Exposure Data

- So we also did source apportionment of PM
 - Where does the PM come from?
 - Construction activities, fires, traffic, power plants, etc
 - What is the PM made of?
 - Carbon
 - Organic compounds
 - Dirt
 - Metals
 - Etc.

Modeled 2013 concentrations ($\mu\text{g}/\text{m}^3$) of $\text{PM}_{2.5}$ fractions apportioned by source and averaged across four Bexar County receptors

Fraction	<u>Texas sources</u>						<u>Non Texas</u>		<u>All</u>	<u>CPS</u>
	Bio- genic	EGU	Non- EGU	Area	MV	Non- road	Oth	BC	Total	
Primary elemental carbon				0.12	0.08	0.15		0.07	0.43	
Primary organic aerosol		0.08	0.10	1.20	0.05	0.11	0.05	0.37	1.96	
Other fine particulate		0.12	0.28	6.29	0.04		0.05		6.78	
Secondary nitrate	0.27	0.24	0.50	0.35	0.66	0.40	0.11	0.10	2.62	
Ammonium				0.97	0.20				1.22	
Secondary sulfate		0.97	0.65	0.33			0.25	0.45	2.67	
Total $\text{PM}_{2.5}$	0.27	1.41	1.54	9.26	1.03	0.68	0.48	1.02	15.67	0.19



Definitions

Sources

- Biogenic from biological sources including grass fires
- EGU, electric generating utilities, gas and coal fired
- non-EGU, other industrial point sources
- area, other sources not included in point sources and vehicles, e.g. agriculture, fireplaces, dirt roads, fires, construction, quarries, bbq grills, restaurants, airports, marine terminals
- MV, motor vehicles
- nonroad, other gasoline and diesel engines such as farm and construction equipment
- other, contributions from outside the United States including Mexico and Canada and offshore oil and gas platform
- BC, boundary conditions are US contributions from outside the state of Texas.



Definitions (cont.)

Organic compounds from the various primary sources and do not account for secondary organics formed in the atmosphere. The term *organic carbon used in some epidemiological work would include both.*

Other fine PM is primary PM and includes metals.

These are the total values attributable to CPS Energy for 2013 in Alpine (2007) and Table 5-1.



Possible Study Biases

- All PM is not equal...the epi studies we had to use make this assumption
 - Gasoline and diesel exhaust appear to be much more important than coal fired power plants (CFPP) emissions
- The long term epi studies are not representative of SA population demographics and meteorology
- The CAMx exposure model is not perfect
 - PM_{2.5} annual average values for the county were 2x higher than seven area CAMS observed in 2002



Possible Study Biases

- Epi studies underestimate effects due to exposure misclassification
- Pollutants likely do not act singularly and thus estimated effects for a single pollutant may be overestimated
- We picked the highest effect estimates from a study if there were more than one



Summary and Conclusions

- Air pollution is not innocuous...any exposure may be harmful to some person
- PM is the most important pollutant in terms of health effects
- PM exposure may be contribute to as many as ~7-20% of non-accidental deaths in Bexar County
- CPS Energy emissions may contribute to perhaps ~0.2% of deaths
- More than half the PM_{2.5} in Bexar County comes from highly diverse and hard to control sources



Mercury (Hg)

- Not regulated the same way as other pollutants
- Health effects not studied the same way
 - EPA sets a dietary limit (0.1 μg Hg/kg body weight)
 - Safe daily allowable intake or reference dose (RfD)
 - EPA's RfD is more conservative than FDA (0.43) or WHO (0.47)
- Main exposure route is in diet
 - Air emissions contaminate soil which runs off to lakes where mercury accumulates in the food chain...fish



Hg Risk Approach

- CAMx showed that the largest CPS Energy Hg depositions were near the plants
- Since diet and fish are major exposure paths, eating fish from the CPS Energy cooling lakes would be largest CPS Energy contribution to exposure
- Fish Hg data were available
- A worst case exposure scenario was used to compare with EPA standard

Worst Case Hg Risk Assessment

- The most contaminated fish are eaten
- Consumption of fish is at the highest level in US populations...4 oz. per day
- Only fish from Calaveras/Braunig lakes are eaten
- An average weight, 3rd trimester, pregnant female consumes the fish
- Exposure would be about equal to the EPA standard

Hg Conclusions

- Braunig and Calaveras lakes fish are safe to eat
- Hg that CPS Energy contributes is about 0.005 % of total deposited
- Most Hg in these lakes likely comes from treated waste water

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