

Treatment of Non-Market Benefits in REMI Model



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Socioeconomic Analysis

South Coast Air Quality Management District

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South Coast AQMD

- **Regional air pollution control agency**
 - ❑ Jurisdiction: Urban portions of Los Angeles, Riverside, and San Bernardino counties, along with all of Orange County.
 - ❑ ~18 million people
 - ❑ Regulate air pollution emissions, mainly stationary sources.
 - ❑ Air Quality Management Plan (AQMP) – Regional blueprint to meet national ambient air quality standards.
 - ❑ In AQMP, socioeconomic report presents **regional benefits from air-quality improvements (reduced ozone and fine particulate matter)**.

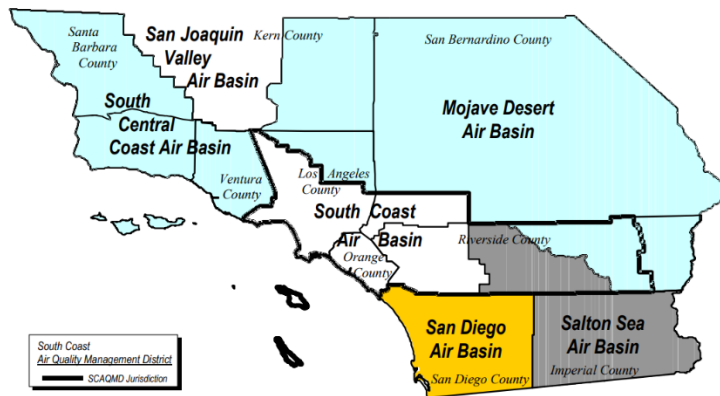


FIGURE 1-2
BOUNDARIES OF THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT AND
NEIGHBORING FEDERAL PLANNING AREAS



Sources

Air Quality

Health

Monetizable Health Benefits from Improving Air Quality

1. Morbidity reduction

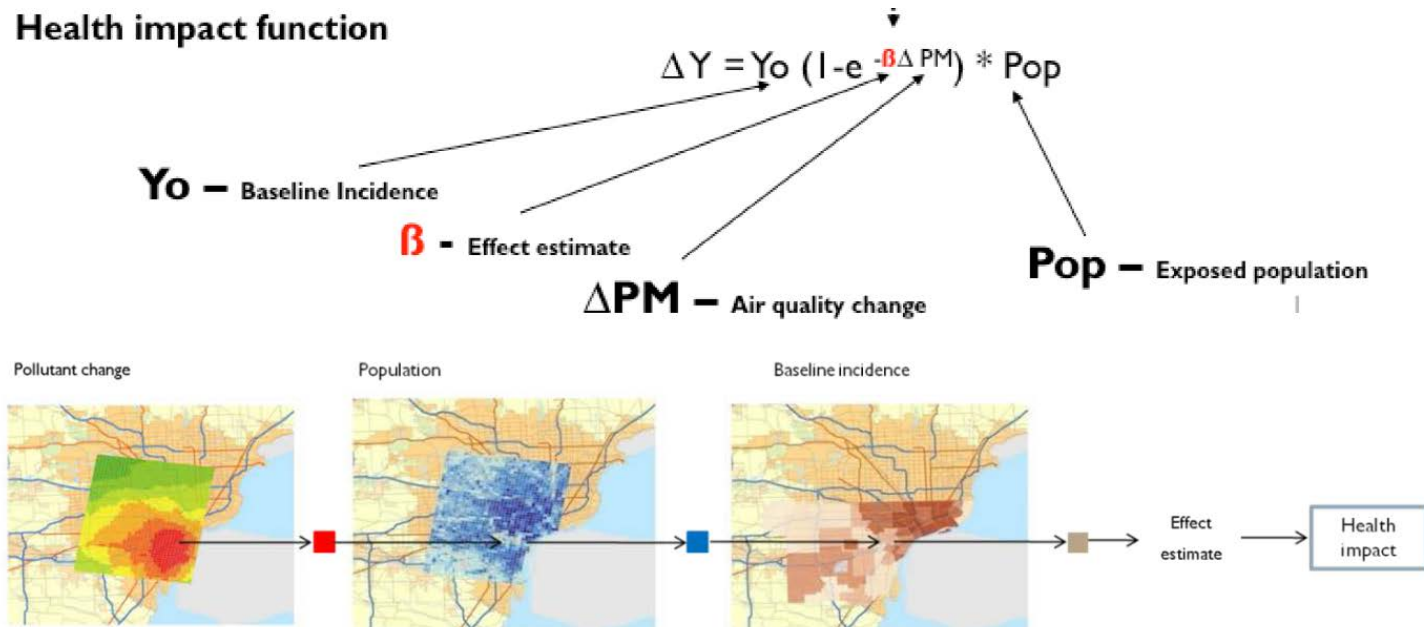
- Reduced hospital visits.
 - Fewer cardiovascular and respiratory impacts.
- Reduced medicinal expenses.
 - Less severe respiratory symptoms (wheezing, coughing, etc.).

2. Mortality reduction

- Lower likelihood of pre-mature mortality due to symptoms caused by air pollution.

Estimating Public Health Benefits - BenMAP

- AQMP implementation improves local air quality.
 - Lower emissions of ozone precursor pollutants and particulate matter.
- Improved air quality results in reduced mortality and morbidity
 - Reduced asthma, bronchitis, stroke, etc.
- EPA's BenMAP software estimates health impacts and values them monetarily.



2016 AQMP Estimated Health Benefits from Meeting Federal Air Quality Standards

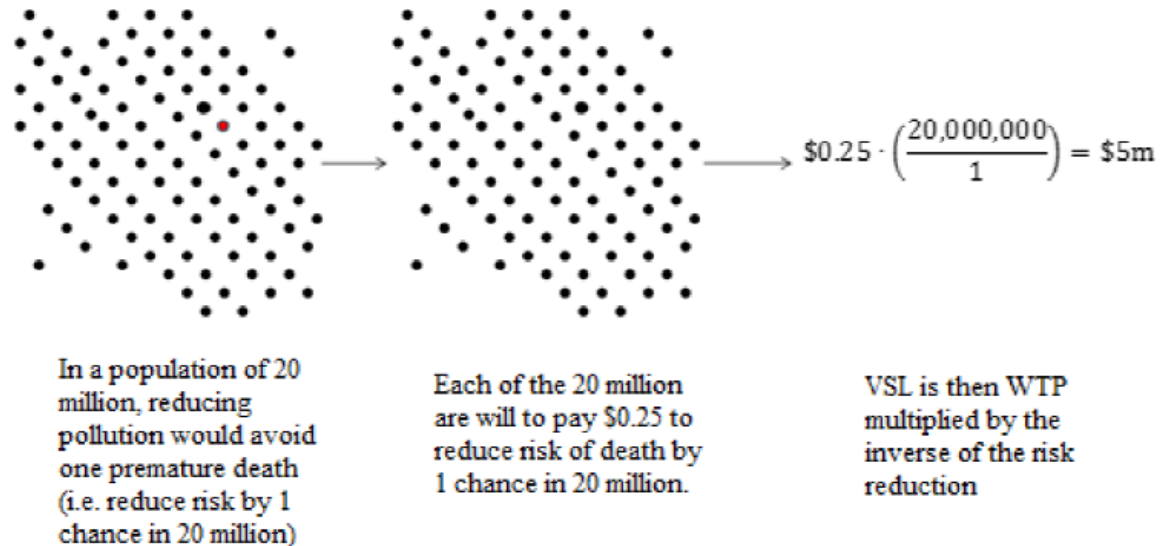
Endpoint	2023	2031	Average Annual (2017-2031)
Premature Deaths Avoided, All Cause			
Short-Term Ozone Exposure	45	89	49
Long-Term PM2.5 Exposure	1,394	2,716	1,512
Short-Term PM2.5 Exposure	100	194	108
Reduced Morbidity Incidence			
Short-Term Ozone Exposure			
Emergency Room Visits, Asthma	2,209	4,154	2,350
Hospital Admissions (HA), All Respiratory	68	148	78
Hospital Admissions (HA), Asthma	64	119	68
Minor Restricted Activity Days	327,312	610,075	346,679
School Loss Days, All Cause	100,034	184,781	105,451
Long-Term PM2.5 Exposure			
Acute Bronchitis	1,039	1,890	1,087
Short-Term PM2.5 Exposure			
Acute Myocardial Infarction, Nonfatal	33	71	38
Asthma Exacerbation (Wheeze, Cough, Shortness of Breath)	23,321	42,780	24,495
Asthma, New Onset (Wheeze)	2,956	5,577	3,151
HA, All Cardiovascular (less Myocardial Infarctions)	164	337	183
HA, All Respiratory (less Asthma)	136	290	155
HA, Ischemic Stroke	79	171	91
HA and ED Visits, Asthma	142	260	149
Lower Respiratory Symptoms	12,268	22,387	12,850
Upper Respiratory Symptoms	24,342	44,720	25,587
Minor Restricted Activity Days	528,869	961,248	552,809
Work Loss Days	91,689	166,826	95,892

Public Health Benefits - Monetization

- **Mortality: Value of Statistical Life (VSL)**

- Based on willingness-to-pay (WTP) estimates for small health risk reduction. Used VSL of \$9 million (2013\$) (Robinson & Hammit, 2016).

Example Approach:



Source: U.S. EPA, modified by Industrial Economics, Inc. and SCAQMD staff

- **Morbidity: Cost of Illness (COI) avoided**

- Reduced direct healthcare cost and reduced indirect cost due to reduced productivity caused by illness (e.g. fewer work days lost and fewer school days missed).

Monetized 2016 AQMP Public Health Benefits

- Based on reduced mortality and morbidity risks resulting from implementing proposed control measures
 - Over 95 percent associated with avoided premature deaths from reduced long-term exposure to PM_{2.5}.



	Year 2023	Year 2031	Average Annual (2017-2031)	Present Value (2017-2031)
Mortality-related benefits	\$14.2	\$30.5	\$16.2	\$170.8
<i>Short-Term Ozone Exposure</i>	\$0.5	\$1.1	\$0.6	\$6.1
<i>Long-Term PM_{2.5} Exposure</i>	\$13.7	\$29.4	\$15.7	\$164.7
Morbidity-related benefits	\$0.2	\$0.4	\$0.2	\$2.4
Grand Total	\$14.4	\$30.9	\$16.5	\$173.2

BenMAP Valuation of Decreased Mortality = Value Reduced Risk of Death

- Total value of mortality reduction =
 - $\# \text{ avoided mortalities} * VSL =$
 - $\text{Pr}(\text{mortality}) * \text{population} * VSL =$
 - $\frac{\# \text{ avoided mortalities}}{\text{population}} * \text{population} * VSL$
- BenMAP valuation of mortality reduction in one year same as annual willingness-to-pay of each region for lower risk of premature mortality due to air pollution.
 - REMI model documentation recommends inputting annualized values.

REMI: Public Health Benefits - Mortality Reduction (1/2)

- REMI values reduced likelihood of pollution-related pre-mature mortality.
 - Indirect compensation viewable as “differed compensation,” i.e. increase in real purchasing power (real wages) without receiving monetarily higher wages.
 - Modeled in REMI using non-pecuniary (amenity) aspects policy variable.
 - If entered as \$ increase in earning across a region – converted to proportion increase in average relative real wage.
 - Other real-world changes can be modeled this way, e.g. improved visibility, changes in crime rates, public services, transportation impacts, etc.

Economic Migration Equation & Amenity Value

- $ECMIG_t^k = \left((\lambda^k + \beta_1 \ln(REO_t^k * MIGPROD_t^k)) + \beta_2 \ln(RWR_t^k * \right.$

REMI: Public Health Benefits - Mortality Reduction (2/2)

- After deliberation with REMI staff and third-party consultant, South Coast AQMD staff found a benefit in:
 - Providing a range of regional economic outcomes based on lower- and upper-bound amenity values
 - Considering only mortality benefits from working-age population (age 25-65) (REMI recommends including all)
 - Providing a range of regional economic outcomes assuming \$1 in social value is worth \$0.50 in amenity value, and then \$1 in amenity value.

REMI: Reduced Mortality Increases Regional Amenity Value

Policy Variable Inputs

Active	Edit	Category	Notes
☒		Composite (126 PV-s)	Reduced Consumer Spending on healthcare industries
☒		Composite (21 PV-s)	Reallocation of reduced healthcare spending
☒		Composite (21 PV-s)	Avoided Mortality Benefits (ages 25-65) at 100%

Items				PV Id								
Active	Category	Detail	Region	Unit Code	Variable Number	2014	2015	2016	2017	2018	2019	2020
☒	Non-Pecuniary (Amenity) Aspects (amount)	Total	Beach & Catalina	2015 Fixed	D41	0	0	0	26174707	54073884	83638575	112054253
☒	Non-Pecuniary (Amenity) Aspects (amount)	Total	Burbank	2015 Fixed	D41	0	0	0	20441113	42331778	65668023	88030685
☒	Non-Pecuniary (Amenity) Aspects (amount)	Total	Central	2015 Fixed	D41	0	0	0	86077703	178831781	277921589	374472248
☒	Non-Pecuniary (Amenity) Aspects (amount)	Total	North	2015 Fixed	D41	0	0	0	6903440	14444352	22641672	30607396
☒	Non-Pecuniary (Amenity) Aspects (amount)	Total	San Fernando	2015 Fixed	D41	0	0	0	46192721	95762913	148429770	198754064
☒	Non-Pecuniary (Amenity) Aspects (amount)	Total	San Gabriel Valley &	2015 Fixed	D41	0	0	0	31481048	65356633	101417384	136227903

- Total WTP used for 2016 AQMP. REMI model converts it to proportion dividing by region's total wage and salary disbursements.

REMI: Public Health Benefits - 2016 AQMP Results and Concerns

	Jobs			Average Annual (2017-2031)	
Primary Scenario	2017	2023	2031	Jobs	% Change
Quantified Public Health Benefits	1,294	21,017	43,481	23,036	0.20%
Mortality-Related Benefits	1,284	20,851	43,282	22,894	0.20%
Morbidity-Related Benefits	10	166	192	144	0.00%
Sensitivity Analysis					
Quantified Public Health Benefits (with Discounted Mortality-Related Benefits)	652	10,591	21,792	11,576	0.10%
Mortality-Related Benefits Discounted by 50%	642	10,425	21,582	11,431	0.10%

- Most positive job impacts stemmed from amenity enhancement due to reduced risk of pre-mature mortality.
 - Average proportion increase in amenity across all regions ≈ 0.03 .

Observations on Amenity in REMI

- General logic behind amenity value increasing economic migration is sound.
- Need to ensure values entered into REMI are **annualized** benefits (not total benefits over a lengthy period of time).
- Potential for interesting new analyses with REMI E3+ model when considering benefits of reduced morbidity and reduced mortality *risk*.
- Important to consider job gains in context with total jobs.

Questions/Comments?

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