To learn more about California's opportunity to combat global warming while simultaneously improving air quality and public health through implementation of the California Global Warming Solutions Act (AB 32), please read the full NRDC issue paper *Boosting the Benefits* at www.nrdc.org/policy.

Boosting the Benefits
Appendix A
Co-Benefits Analysis Methods

We analyzed the air quality and public health benefits of potential AB 32 measures including those contained in the CAT report, as well as additional measures. The fuel and energy avoided, as well as resulting NO_x and PM emission reductions were derived directly from the most recent update of the CAT report. Health impacts from exposures to ozone (formed from NO_x precursors) and PM (direct and indirectly fromed from NO_x emissions) were then evaluated according to the health risk assessment methodology established by the California Air Resources Board (CARB) *Goods Movement Emission Reduction Plan (GMERP)*; health costs were similarly estimated according to the CARB *GMERP*.[1]

The measures we evaluated are included in the following table, categorized by origin: CAT report,[2] Early Action Measures (EAMs) and 35 other measures adopted in October 2007,[3] and Additional measures proposed by NRDC for the Scoping Plan.[4] These measures that we analyzed, listed in Table 1, are a subset of the CAT and EAM measures. . Measures from any of the three categories that do not have clear fuel or energy reductions associated with them were not included. For example, we were unable to assess the health co-benefits of measures that reduce pollutants such as refrigerants, even though they have high global warming potential.

Table 1: Global Warming Pollutant Reduction Measures Analyzed for Co-Benefits		
Category	**Type**	**Individual Measures**
CAT	Renewable Energy	Accelerate RPS to 33% by 2020 (IOU + Muni)
CAT	Energy Efficiency	Appliance Efficiency Standards in Place
CAT	Energy Efficiency	Building Energy Efficiency Standards in Place
CAT	Renewable Energy	California Solar Initiative
CAT	Other	Cement Manufacturing
CAT	Energy Efficiency	Comprehensive Municipal Utility Program (EE)
CAT	Cleaner Power	Comprehensive Municipal Utility Program (No Coal)
CAT	Cleaner Cars & Trucks	Diesel Anti-idling
CAT	Cleaner Cars & Trucks	Fuel Efficient Tires
CAT	Energy Efficiency	Green Buildings Initiative
CAT	Cleaner Cars & Trucks	Heavy-duty Vehicle Emission Reduction Measures
CAT	Energy Efficiency	IOU Additional Energy Efficiency Programs
CAT	Energy Efficiency	IOU Energy Efficiency Programs
CAT	Smart Growth	Measures to Improve Transport Energy Efficiency, Smart Land Use, and Intelligent Transportation (Smart Growth)
CAT	Cleaner Cars & Trucks	Other Light-duty Vehicle Tech Improvements ("Pavley II")
CAT	Low-Carbon Fuel	Shore Electrification for Marine Vessels
CAT	Energy Efficiency	Stationary Refrigeration & AC Sources
CAT	Forestry	Urban Forestry
CAT	Cleaner Cars & Trucks	Vehicle Climate Change Standards ("Pavley")
CAT	Water Efficiency	Water Use Efficiency
EAM	Cleaner Cars & Trucks	Diesel Truck Clean Up Regulation
EAM	Low-Carbon Fuel	Electrify Stationary Agricultural Irrigation Pump Engines
EAM	Cleaner Cars & Trucks	Tire Pressure Program
EAM	Low-Carbon Fuel	Truck Stop Electrification
EAM	Cleaner Cars & Trucks	Vessel Speed Reduction
Proposed	Energy Efficiency	CEC Title 24 and 20 standards updates
Proposed	Energy Efficiency	EE Standards for homes, time-of-sale
Proposed	Low-Carbon Fuel	Freight Measures
Proposed	Water Efficiency	Water Efficiency (Additional)

In addition to the measures listed in Table 1, we assumed ten percent reductions of NO_x and PM in 2020 across three sectors that lack fully defined measures to reduce global warming pollution: Petroleum refining, oil and gas extraction, and agriculture. We also assumed ten percent NO_x and PM reductions across the board in 2020 for electric utilities, because the existing slate of energy measures did not account for the significant co-benefits that are likely from upgrading highly polluting power plants. Hypothetical health co-benefits from these sectors were estimated using the methodology described below, using the CARB 2020 emissions inventory as the basis for emission reductions (multiplied by 0.1 to account for the ten percent reduction assumption).[5] Reductions of NO_x and PM emissions assumed for each sector are listed in Table 2.

Table 2: Criteria Pollutant Emission Reductions Associated with 10 percent Emission Reductions for the Following Sectors		
Sector: 10% Reductions	**NO_x (tons, 2020)**	**$PM_{2.5}$ (tons, 2020)**
Petroleum Refineries	1,098	205
Oil and Gas	778	69
Agriculture (Farming Operations)		1,540
Electric Utilities	1,205	231
Total	3,081	2,044

Co-benefits analysis Step 1: Calculating NO_x and PM reductions

NO_x and PM reductions for each measure were taken from existing data directly listed in the CAT or EAM documents, or contained in the additional measures proposed by NRDC for the Scoping Plan[6]. In many cases, NO_x and PM emission reductions were calculated based on the factors in Table 3 relating fuel or energy savings to emission reductions.

Table 3: Criteria Pollutant Emission Factors			
Fuel	**NO_x**	**PM_{10}**	**Units**
Electricity	0.018	0.018	kg/MWh
Natural Gas	0.1		lb/MMBTU
Gasoline: Upstream Emissions Avoided	0.022	0.066	kg/1000 gallons
Gasoline: Combustion Emissions Avoided	9.3	0.9	kg/1000 gallons
Diesel Fuel Combustion Emissions Avoided	140	0.25	kg/1000 gallons

Source: CAT Update , "Updated Macroeconomic Analysis…" Exhibit 7Natural Gas factor from Energy and Environmental Economics, *Methodology and Forecast of long term avoided costs for the evaluation of California Energy Efficiency Programs*, for the California Public Utilities Commission, October 25, 2004.

Note: Identical factors for NO_x and PM_{10} is unusual (as is the case here for electricity). CARB and CalEPA staff have verified that these factors are correct.

Table 4 lists measures taken from the CAT report, associated fuel and energy savings, emission factors applied and adjustments to certain measures. For example, some of the measures in the CAT report were also contained in the EAM document with updated information.

Table 4: CAT Strategies Analyzed, including projected fuel & power savings for 2020

Individual Measures	Avoided Gasoline (Thousand gallons)	Avoided Diesel (Thousand gallons)	Avoided Natural Gas (MMBtu)	Renewable Electric Supply (MWh)	Avoided Electric Demand (MWh)	Criteria Pollutant Emission Factor Used
Vehicle Climate Change Standards ("Pavley")	3,033,000					Gas (Up Stream)
Diesel Anti-idling[1]		146,000				Diesel Comb.
Other LDV Tech Improvements	595,000					Gas (Up Stream)
Stationary Refrigeration & AC Sources					1,796,000	Electricity
Shore Electrification[2]		86,000			-1,000,000	Diesel Comb. & Electricity
HDV Emission Reduction Measures	11,000	304,000				Gas upstream & Diesel Comb.
Landfill Methane Capture				2,210,000		
Zero Waste - High Recycling				601,155		
Fuels Management/ Biomass				4,609,000		
Urban Forestry				1,764,000	163,000	Electricity
Water Use Efficiency					1,626,000	Electricity
Building Energy Efficiency Standards in Place			9,603,440		5,219,688	Electricity
Appliance Efficiency Standards in Place			9,926,840		12,635,358	Electricity
Fuel Efficient Tires	38					Gas (Up Stream)
Cement Manufacturing[3]					160,715	Electricity
Comprehensive Municipal Utility Program (EE)					16,200,000	Electricity
Comprehensive Municipal Utility Program (No Coal)					13,500,000	Electricity
Measures to Improve Transport Energy Efficiency, Smart Land Use, and Intelligent Transportation[4]	776,500					Gas Combustion
Green Buildings Initiative			7,504,225		4,479,887	Electricity
Accelerate RPS to 33% by 2020 (IOU + Muni)[5]					26,815,845	Electricity
California Solar Initiative					2,939,007	Electricity
IOU Energy Efficiency Programs			10,650,219		9,874,985	Electricity
IOU Additional Energy Efficiency Programs			18,817,921		14,714,654	Electricity
Total	**4,415,538**	**536,000**	**56,502,645**	**9,184,155**	**109,125,139**	

[1]Diesel Anti-Idling Criteria Pollutant Reductions taken from EAMs document, page C-20

[2] Shore Electrification data on NO_x and PM emission reductions taken from Staff Initial Statement of Reason for Final Regulation on ShorePower, December 2007.

[3] Strategy benefits taken from NRDC Recommendations for Policies to Reduce Global Warming Pollution for the AB32 Scoping Plan. October 1st, 2007. It was assumed that all coal would be phased out by 2020, leading to reductions of 2,895.44 tons NO_x and 97.31 tons PM2.5 according to the CARB 2020 Emission Inventory.

[4] Smart Growth, fuel saved based on Assumption of 5% reduction of VMT equivalent to 5% reduction in fuel use in 2020; Fuel estimate taken from CEC Base fuel price with GHG standards scenario, Table 8, page 16, CEC Trans Energy Forecasts 600-2007-009.

[5] RPS Electricity avoided taken from UCS et. al. Scoping Plan proposal, 36,000 GWh incremental renewable energy in 2020 minus Renewable natural gas electric supply.

Note that several of the measures in this table have been included for the sole reason of showing renewable natural gas, which was subtracted from the electricity avoided by the RPS measure. Co-benefits were not estimated for these measures.

Table 5 summarizes the additional measures that were analyzed, and fuel and electricity savings and/or projected emission reductions.

Table 5: Additional Measures, fuel and electricity savings and emission reductions for 2020

Strategy	Source	NO_x (tons)	PM (tons)	Criteria Pollutant Emission Factor Used; Fuel & Electricity Savings; Comments
Truck Stop Electrification[1]	EAM C-81	896	39	
Vessel Speed Reduction	EAM C-85	667	18	30% rdxn in NO_x, DPM, SO_x applied to emissions inventory for foreign ships in transit, 2020 (6.1 tpd NO_x; 0.16 tpd $PM_{2.5}$)
Electrify Stationary Ag Engines	EAM C-90	1,251	89	20% of all Ag engines to be electrified by 2020 (17.1 tpd NO_x; 1.22 tpd $PM_{2.5}$)
Tire Inflation	EAM B22	1	2	Upstream gasoline emission avoided; 22,500 gallons gasoline saved.
EE Standards for homes, time-of-sale	NRDC SPP	1,389	106	Emissions reductions as reported in scoping plan proposal.
Water Efficiency	NRDC SPP	273	273	Electricity factor; 13.7 million MW electricity saved in addition to CAT water efficiency measure.
Diesel Trucks	CARB	35,405	1,898	Emission reductions taken from CARB Statewide Truck and Bus Proposed Regulation, presentation, Feb. 11, 2008.
CEC Title 24 and 20 stds updates Building EE stds update	NRDC/ CEC	3,358	256	NO_x and PM reductions were scaled proportionally to Time of Sale EE measure for homes based on projected CO_2 reductions.
Freight Measures	NRDC SPP			
1) Improve freight logistics, reducing heavy-duty diesel truck fuel use by 2 %		2,038	76	Total inventory for heavy-heavy duty diesel trucks, 2020: 279.1 tpd NO_x; 10.37 tpd $PM_{2.5}$.
2) Electrify up to 1% of the heavy-duty diesel truck fleet		1,019	38	Total inventory for heavy-heavy duty diesel trucks, 2020: 279.1 tpd NO_x; 10.37 tpd $PM_{2.5}$.
3) Electrify 5% of cargo rail		2,182	70	Total inventory for diesel rail, road hauling 2020: 119.5 tpd NO_x; 3.81 tpd $PM_{2.5}$.
4) Hybridize 50% of Switchers (50% diesel fuel use reduction)		551	12	Total inventory for diesel rail, switching 2020: 6.0 tpd NO_x; 0.14 tpd $PM_{2.5}$.
Total		**49,259**	**2,897**	

Notes:
[1] Emission reductions for 2010, 2020 data unavailable.

"Emission Inventory" refers to that posted by CARB: http://www.arb.ca.gov/ei/ei.htm
CEC= California Energy Commission

SPP = Scoping Plan Proposal
Tpd = tons per day

Co-Benefits Analysis Step 2: Estimating Health Impacts Avoided Due to Projected Emissions Reductions

Health Impacts for each measure were estimated as the sum of each pollutant in tons (P), divided by the respective factor for tons per case of health endpoint (fHEP).

Total Health Impacts = P ($PM_{2.5}$)/ fHEP ($PM_{2.5}$) + P (NO_x)/fHEP (NO_x)

Factors for Health End Points (fHEP, as tons per case of health endpoint) are taken from CARB's *GMERP, Technical Supplement on Quantification of the Health Impacts and Economic Valuation of Air Pollution from Ports and Goods Movement in California*, p. 49. Air basin-specific health endpoint factors were aggregated into statewide average factors, weighted by population. The average California health endpoint factors are listed in Table 6

The health endpoint factors developed for use in the *GMERP* and summarized here represent health impacts associated with $PM_{2.5}$ that is directly emitted and also indirectly formed as particle nitrate by NO_x emissions. Health impacts due to ozone formed from NO_x precursor emissions are also included. While health impacts for PM in the *GMERP* were taken to represent diesel PM exposures, they were developed using general $PM_{2.5}$ concentration-response functions from the ambient $PM_{2.5}$ studies listed in Table 6[7] which were applied here to non-diesel sources of $PM_{2.5}$. Health endpoint factors for $PM_{2.5}$ were developed by applying concentration-response functions from the sources listed in Table 7 to estimated $PM_{2.5}$ concentrations in each air basin. Associations were then developed between the emission inventory for a base year (2000) and health impacts calculated for that year. These associations are the health endpoint factors.

The *GMERP* describes a similar approach for estimating ozone health endpoint factors. This was based on data from a 2005 review of the California ozone standards, using measured concentrations during 2001 to 2003, and following a health benefit assessment approach used by US EPA.[8] Ozone concentration-response functions were based on studies in listed in Table 8.

Table 6: Population Weighted Statewide Average Health Endpoint Factors (tons per case of health endpoint)

	NO_x	$PM_{2.5}$
Death	647.99	16.31
Hospitalization (respiratory)	3,162.78	80.95
Hospitalization (cardiovascular)	1,718.54	44.03
Asthma and other LRS	25.86	0.63
Acute Bronchitis	310.63	7.60
Work Loss Days	4.17	0.11
Minor Restricted Activity Days	0.72	0.02

Table 7: $PM_{2.5}$ Concentration-Response Functions			
Endpoint	**Location**	**Age**	**Author**
Mortality, All Cause	51 U.S. cities	30+	Pope et al. (2002)
	Los Angeles	30+	Jerrett et al. (2005)
	86 U.S. cities	<1	Woodruff et al. (1997)
	California	<1	Woodruff et al. (2006)
Hospital Admissions, All Cardiovascular	14 U.S. cities	65+	Zanobetti and Schwartz (2003)
	Los Angeles, CA	65+	Moolgavkar (2003[a])
	Los Angeles, CA	18-64	Moolgavkar (2000b)
Hospital Admissions, Chronic Lung Disease	14 U.S. cities	65+	Zanobetti and Schwartz (2003)
Hospital Admissions, Pneumonia	14 U.S. cities	65+	Zanobetti and Schwartz (2003)
Hospital Admissions, Chronic Lung Disease	Los Angeles, CA	18-64	Moolgavkar (2000a)
Hospital Admissions, Chronic Lung Disease	Los Angeles, CA	65+	Moolgavkar (2003a)
Hospital Admissions, All Respiratory	Los Angeles, CA	30+	Linn et al. (2000)
Lower Respiratory Symptoms (including asthma related effects)	6 U.S. cities	7-14	Schwartz and Neas (2000)
Acute Bronchitis	24 communities	8-12	Dockery et al. (1996)
Minor Restricted Activity Days	Nationwide	18-64	Ostro and Rothschild (1989)
Work Loss Days	Nationwide	18-64	Ostro (1987)
Asthma Exacerbation, Cough	Los Angeles, CA	8-13	Ostro et al. (2001)
Asthma Exacerbation, Shortness of Breath	Los Angeles, CA	8-13	Ostro et al. (2001)
Asthma Exacerbation, Wheeze	Los Angeles, CA	8-13	Ostro et al. (2001)
Acute Bronchitis, among asthmatics	Southern California	9-15	McConnell et al. (1999)
Chronic Phlegm, among asthmatics	Southern California	9-15	McConnell et al. (1999)

Source: *GMERP*, at A-38.

Table 8: Ozone Concentration-Response Functions			
Endpoint	**Location**	**Age**	**Author**
Mortality, Non-Accidental	95 U.S. cities	All ages	Bell et al. (2004)
	15 European cities	All ages	Anderson et al. 2004
	Multiple U.S. cities	All ages	Levy et al. (2001)
	Multiple cities	All ages	Stieb et al. (2002)
	Multiple cities	All ages	Thurston and Ito (2001)
	23 European cities	All ages	Gryparis et al. (2004)
	Multiple U.S. cities	All ages	Bell et al. (2005)
	Multiple U.S. cities	All ages	Ito et al. (2005)
	Multiple U.S. cities	All ages	Levy et al. (2005)
Hospital Admissions, All Respiratory	Toronto, Canada	All ages	Thurston and Ito (1999)
School Loss Days, All Cause	Southern California	6-18	Gilliland et al. (2001)
Minor Restricted Activity Days	Nationwide	18-64	Ostro and Rothschild (1989)

Source: *GMERP*, at A-39.

PM_{10} emission reductions were converted to $PM_{2.5}$ using factors in Table 9, which were calculated by averaging the ratio of PM_{10} to $PM_{2.5}$ for the years 2000, 2005, 2010, 2015, and 2020, for specific source categories. For instance, the calculation for Ocean Going Vessels took the ratio of PM_{10} to $PM_{2.5}$ for the source category "Other Mobile Sources, Ships and Commercial Boats" for the years 2000, 2005, 2006, 2010, 2015, and 2020, and found the average of the six ratios.

Table 9: Conversion Factors	
Electricity Ratio $PM_{10}/PM_{2.5}$	1.05
Ocean Going Vessel Ratio $PM_{10}/PM_{2.5}$	1.03
Diesel Truck Ratio $PM_{10}/PM_{2.5}$	1.15
Light-duty Vehicle Gas Ratio $PM_{10}/PM_{2.5}$	1.62
Heavy-duty Vehicle Gas Ratio $PM_{10}/PM_{2.5}$	1.84

Source: *CARB Almanac:* http://www.arb.ca.gov/app/emsinv/emssumcat.php

Co-Benefits Analysis Step 3: Estimating Health Benefits Ranking for Individual Measures

The Health Benefits Ranking was estimated for each of the CAT, EAM and SPP measures analyzed according to the following formula.

$$\text{Health Benefits Ranking} = (ER_{NOx})/fHEP_{M,\,NOx}) + (ER_{PM2.5})/fHEP_{M,\,PM2.5})$$

Where, ER = Emission Reductions for each individual measure, and fHEPs for mortality (M) only were used. The numbers obtained from this formula were then ranked from greatest (1) to least (28).

Co-Benefits Analysis Step 4: Estimating Costs of Health Impacts Avoided

Costs per health endpoint similar to those in the *GMERP,* but updated to $2007, were applied to the total sum of each type of health endpoint.[9] Health cost benefits were reported as a range of values based on a discount factor from 3% to 7%; values are listed in Table 10.

Table 10: Unit Health Effects Valuations: 2007$, adjusted for income growth in 2020

	Value of a Statistical Life	Respiratory Hospitalizations	Cardiovascular Hospitalizations	Acute Bronchitis	Lower Respiratory Symptoms	Minor Restricted Activity Days	Work Loss Days	School Absences
Discounted at 3%	$7,013,371	$29,160	$35,607	$327	$14	$46	$168	$77
Discounted at 7%	$4,439,848	$18,460	$22,541	$207	$9	$29	$106	$49

Source: *CARB*, May 2008, personal communication from staff.

Co-Benefits Analysis Step 5: Mapping Localized Impacts

We selected three sectors to map, based on the fact that they are known to emit substantial quantities of CO_2, as well as emitting air pollutants with the potential to impact local communities' health. The sectors in California that were mapped include: Electric utilities, cement kilns and petroleum refineries. All cement production facilities and petroleum refineries operating in California and reporting emissions in the CARB database were included.[10] Not all electrical utilities or "power plants" were included in the mapping exercise, since California contains almost 1,000 power generating facilities.[11] We selected the following power plants for inclusion in the maps:

- All 106 natural gas ("Oil/Gas") plants > 50 MW
- All 12 coal plants
- All other plants that were within the top 20 polluters of PM, NO_x or CO_2 according to the ARB and CARMA databases respectively.

We mapped two attributes for each facility within the three sectors: CO_2 (tons in 2007), and a Health Impacts Index. CO_2 emissions were obtained from the following sources and methods.

- Power Plants: CARMA database, www.carma.org; 2007 data
- Petroleum Refineries and Cement Kilns: Direct CO_2 emissions for each facility were unavailable. Instead, CO_2 emissions were apportioned to each facility from that facility's contribution to the total sectorwide NOx emissions. Essentially, NO_x emissions were used as a surrogate to estimate CO_2 emissions for lack of facility-specific CO_2 data. This means that facilities controlling NO_x emissions may artificially appear to contribute less CO_2.
- Refining total CO_2, 2004: 34.88 MMT[12]
- Cement Kilns total CO_2, 2004: 10.75 MMT[13]
- NO_x emissions from both sectors from the 2005 ARB emission inventory

The Health Impacts Index was created to represent relative potential health impacts among the facilities mapped, based on a methodology similar to that used to estimate the health benefits ranking, detailed above. The Health Impacts are displayed on the map in three different colors for "higher risk," "medium risk" and "lower risk" divided evenly to represent the top third of facilities with highest Health Impacts Indices, the middle third and the bottom third. Some facilities have no color, indicating that NO_x and PM emissions data with which to calculate a Health Impact Index

was unavailable. We were unable to locate these facilities in the CARB emissions inventory.[14] For all three sectors, the Health Impacts Index was estimated for each facility based on the following formula:

$$HI_I = (NO_x/fHEP_{AB}) + (PM_{2.5}/fHEP_{AB})$$

Where, HI_I = Health Impacts Index
NO_x = NO_x emissions in 2005, from the CARB emissions inventory
$fHEP_{AB}$ = Air basin specific health endpoint factor for premature mortality; See Table 11.
$PM_{2.5}$ = Total PM / Ratio (Total PM:$PM_{2.5}$); See Table 12 for ratios.

Table 11: Health Endpoint Factors for Air Basins ($fHEP_{AB}$ per ton of pollutant)

Air Basins	NO_x	$PM_{2.5}$
Mojave Desert	980	85.5
North Coast	2,750	89.8
North Central Coast	1,730	30.0
South Coast	193	6.5
South Central Coast	777	20.5
San Diego	317	11.8
San Francisco Bay	1,030	12.7
San Joaquin Valley	1,020	27.8
Salton Sea	538	15.7
Sacramento Valley	973	20.1

Table 12: Ratios of Total PM to $PM_{2.5}$

Petrol Refining Ratio Total PM:$PM_{2.5}$,	1.08
Cement Ratio Total PM:$PM_{2.5}$,	1.53

Source: *CARB* 2006 Emission Inventory

Limitations and Assumptions

The analysis done here is intended to convey the relative magnitude of potential health co-benefits of a suite of measures considered for global warming pollution reductions. Benefits assessed for each individual measure should be considered relative to other measures, and as "ballpark" figures. Uncertainties surrounding this analysis include but are not limited to the following:

All uncertainties identified and discussed in the *GMERP* as it relates to this analysis, since the methodology therein was closely followed here.

Errors in databases and source reports: We made every effort to correct all errors that were noted, however many errors may have gone undetected.

Some information from databases and reports cited for this analysis may have been misinterpreted or incorrectly matched; for example, power plants in California often use different names when reporting to different databases, creating a challenge matching CARMA CO_2 data with CARB emission inventory data.

The fHEPs were originally designed for use with diesel pollution sources and within specific air basins. This analysis used the same health endpoints for stationary and non-diesel mobile sources on the premise that the concentration-response functions used to develop the factors were based on ambient PM2.5 levels from many different sources (i.e. the ambient urban pollutant mix). The health endpoint factors for each air basin were aggregated statewide, weighted by population. The average factors likely under-estimate health impacts because, although mobile sources can be expected to be distributed roughly proportionally with population, our mapping indicates that most of the largest stationary sources are in highly urbanized areas. Therefore, if we had been able to pinpoint the location of reduced energy use and/or production, for example, the health benefits would likely be much greater since this would likely occur in the most densely populated areas.

Uncertainty surrounding health impacts ranges from roughly 15% to 75% of the central effect estimate value for most health endpoints.[15]

Endnotes

1 CARB, *Goods Movement Emission Reduction Plan (GMERP)*, April 2006. See: http://www.arb.ca.gov/planning/gmerp/gmerp.htm

2 Updated Macreconomic Analysis of Climate Strategies Presented in the March 2006 Climate Action Team Report, Final Report" Prepared By: Economics Subgroup Climate Action Team October 15, 2007. Exhibit 12.

3 CARB, *Expanded list of early action measures to reduce greenhouse gas emissions in California recommended for board consideration*, October 2007. http://www.arb.ca.gov/cc/ccea/meetings/ea_final_report.pdf

4 All scoping plan proposals submitted to ARB are posted at http://www.arb.ca.gov/cc/scopingplan/submittals/submittals.htm.

5 The CARB emissions inventory is available online at http://www.arb.ca.gov/ei/ei.htm.

6 All scoping plan proposals included here were submitted by NRDC, except for data on energy savings from a 33% RPS taken from UCS et. al.

7 GMERP at A-61.

8 GMERP at A-62.

9 Updated health costs in 2007 dollars were provided by CARB, May 2008.

10 Cement facilities reporting as SIC 3241; http://www.arb.ca.gov/app/emsinv/facinfo/faccrit.php?dd=&grp=1&sort=FacilityNameA&dbyr=2005&ab_=&dis_=&co_=&fname_=&city_=&fzip_=&fsic_=3241&facid_=&all_fac=C&displayit=Pollutant&showpol=&showpol2=Refineries reporting as SIC 2911; http://www.arb.ca.gov/app/emsinv/facinfo/faccrit_output.csv?&dbyr=2005&ab_=&dis_=&co_=&fname_=&city_=&sort=FacilityNameA&fzip_=&fsic_=2911&facid_=&all_fac=C&chapis_only=&CERR=&dd=

11 CEC database of operational power plants, 2007, 980 facilities listed; http://www.energy.ca.gov/database/POWER_PLANTS.XLS

12 Source: http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_by_sector_2007-11-19.xls Note: April 11, 2008 AB 32 Implementation workshop presentation notes 35 MMT CO_2 in 2004.

13 Source: 2004 ARB GHG inventory Note: Presentations at AB 32 Implementation Workshop, April 10, 2008 list 10.1 MMT CO_2 from 2006 survey data

14 We contacted major air districts seeking assistance; some air districts, such as Bay Area, Mohave and San Diego, provided missing data; others did not. The South Coast air district directed us to their online facility look up tool, which we used to find information on most of the facilities that were missing data.

15 CARB, Technical Support Documents for the In-Use On-Road Diesel-Fueled Heavy-duty Drayage Trucks at Ports and Intermodal Rail Yard Facilities Regulation, Appendix F, December 2007. Available at: http://www.arb.ca.gov/regact/2007/drayage07/drayage07.htm