

# Macroeconomic Impacts Assessment of 2016 Air Quality Management Plan



**Shah Dabirian, Ph.D.**

**Anthony Oliver, Ph.D.**

**Socioeconomic Analysis**

**South Coast Air Quality Management District**

**Los Angeles, California**

**REMI User Conference**

**October 25, 2017**

# What does SCAQMD do?

- **Control air pollution to protect public health**
  - ❑ Jurisdiction: Orange County and the urban portions of Los Angeles, Riverside and San Bernardino counties
  - ❑ Regulate emissions of air pollutants from a multitude of sources, mostly “stationary”



**Sources**

**Air Quality**

**Health**

# How does SCAQMD control air pollution?

Air Quality  
Management Plan

Regulations and Incentives  
Carrots and Sticks

Public Outreach  
& Enforcement

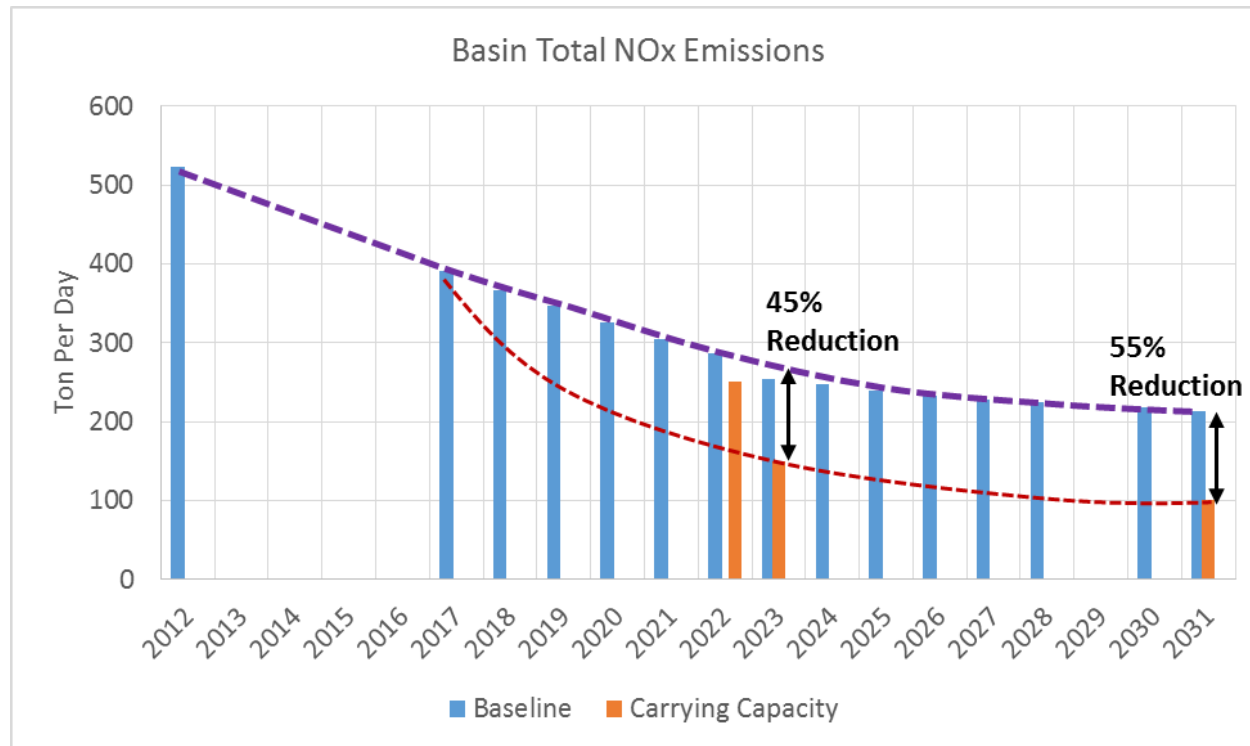


# 2016 Air Quality Management Plan

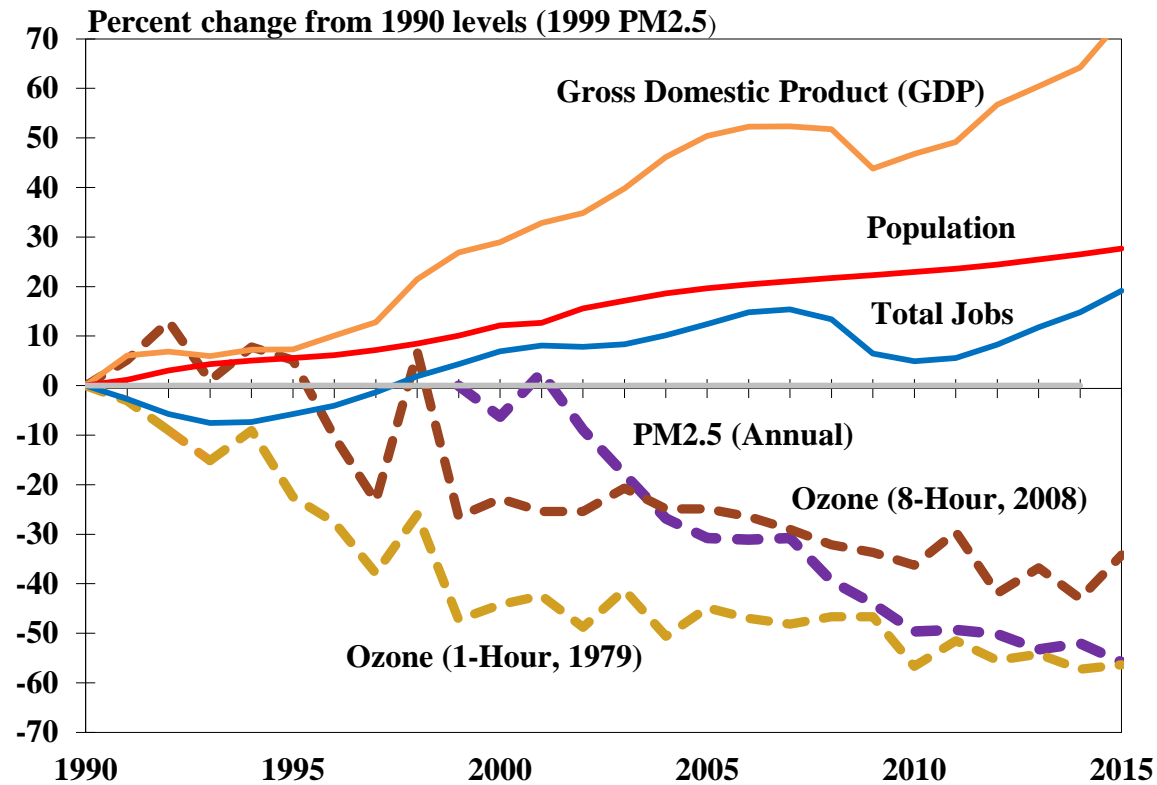
- The 2016 Air Quality Management Plan (AQMP) is a regional blueprint for attaining federal air quality standards in the South Coast Air Basin and Coachella Valley, which are home to about 17 million people.



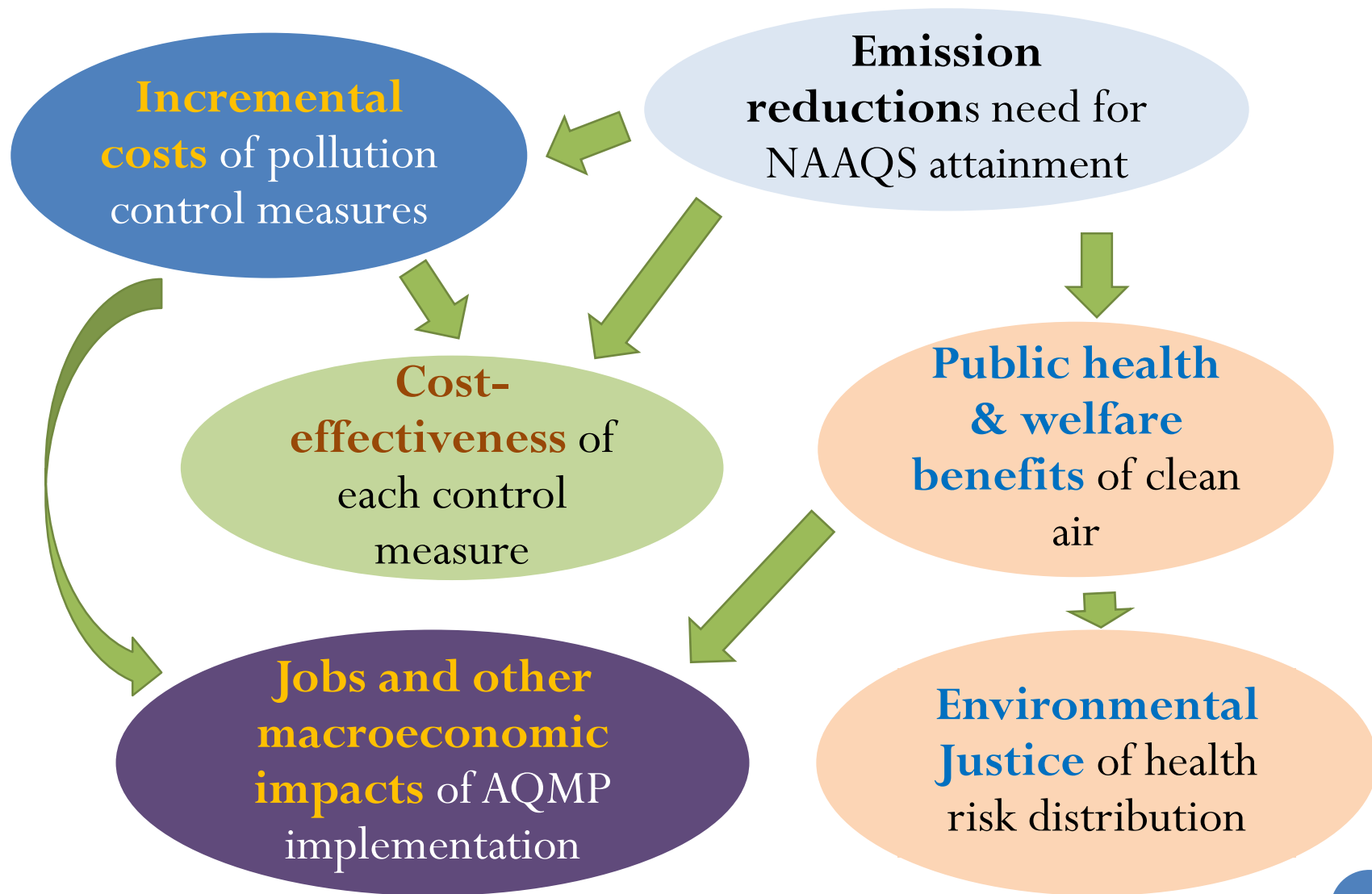
# Emission Reductions Needed for NAAQS Attainment



# Air Quality Trend and Economy



# AQMP socioeconomic analysis



## Incentive Funding Proposed in 2016 AQMP

- Accelerate early deployment of zero and near-zero technologies for mobile and stationary sources
- Significant expansion of financial incentive programs needed
- **Mobile Source** emission reduction estimated total funding range -10 to \$12 billion over the next 15 years
- **Stationary Source** emission reduction (residential, commercial, small business) estimated total funding Range - \$1 to \$2 billion over the next 15 years



~ \$1 billion/year



# Incremental Cost Compilation Stationary Source (Example)

*ECC-03 (Additional enhancements in reducing existing residential building energy use)*

Capital cost assumptions:

Equipment Name	Affected Industries (NAICS)	Per Unit Cost	Per Unit Incentive Amount	Number of Units	Years of Equipment Life
Water Heater (Electric Heat Pump)	Consumers	\$400	\$200	1,690,530	14

Annual operating and maintenance net cost/(savings) assumptions:

Equipment Name	Per Unit Cost No Solar	Per Unit Cost With Solar
Water Heater (Electric Heat Pump)	\$15	\$(132)

Control Measure	Present Value of Remaining Incremental Cost	Present Value of Incentives	Present Worth Value of Total Incremental Cost	Amortized Annual Average (2017-2031)
ECC-03	\$246.6	+ \$406.9	= \$653.5	\$37.8

# Estimated costs of 2016 AQMP

Measures	Present Worth Value of Costs over Equipment Life (Billions of 2015 dollars)					Average Annual Amortized Cost (2017-2031) 2015\$B
	Remaining Incremental Cost		Incentives		Total Incremental Cost	
SCAQMD Stationary Source	\$4.3	+	\$1.4	=	\$5.7	\$0.25
SCAQMD Mobile Source	<\$0.1	+	\$0.6	=	\$0.6	\$0.05
CARB Mobile Source	-\$3.3	+	\$12.6	=	\$9.4	\$0.54
Total	\$1.1	+	\$14.6	=	\$15.7	\$0.85

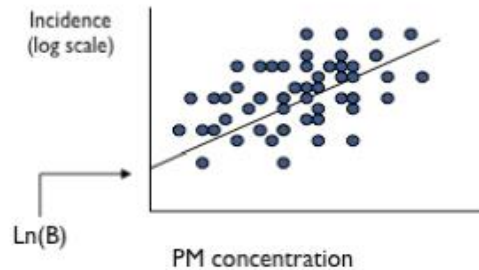
*Note: Numbers may not sum up due to rounding.*

# Estimating Public Health Benefits

- SCAQMD's Air Quality Management Plan improves the air quality in Southern California.
- These benefits take the form of reduced mortality and morbidity (eg. asthma, bronchitis) incidence.
- We use Health Impact Methods from BenMAP software to estimate the health impacts and value them monetarily.
- These benefits have a positive impact on the regional economy, increasing economic output and employment, though the healthcare sector is negatively impacted.
- Productivity increases from reduced work-loss days, display significantly different impacts depending on policy variable

# Public health benefits

## Epidemiology study



$$\text{Ln}(y) = \text{Ln}(B) + \beta(\text{PM})$$

## Health impact function

$$\Delta Y = Y_0 (1 - e^{-\beta \Delta \text{PM}}) * \text{Pop}$$

$Y_0$  – Baseline Incidence

$\beta$  – Effect estimate

$\Delta \text{PM}$  – Air quality change

$\text{Pop}$  – Exposed population

Pollutant change



Population



Baseline incidence



Effect  
estimate

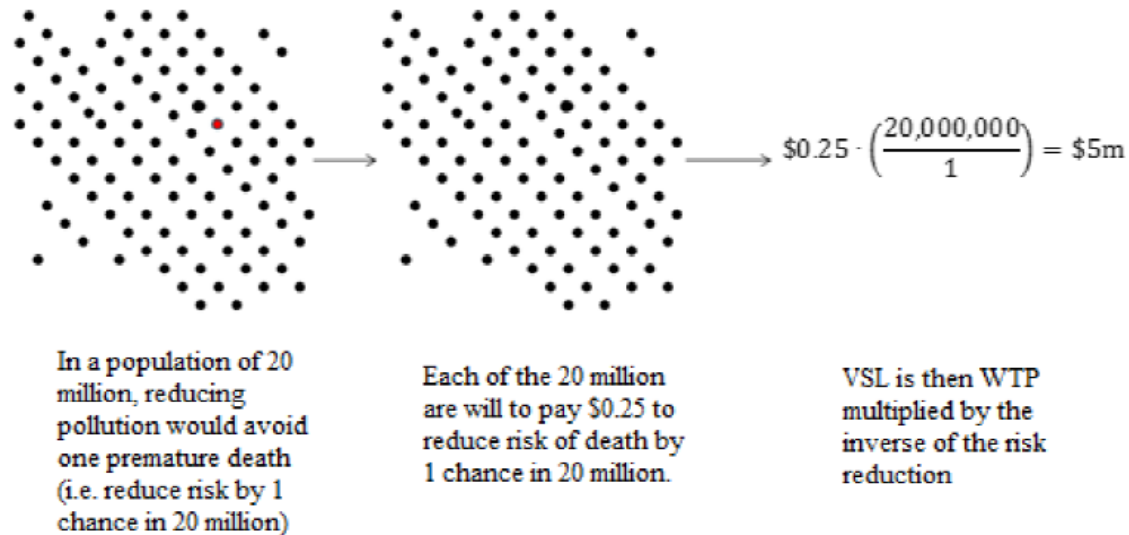
Health  
impact

# Estimated Health Impacts

Endpoint	2023	2031	Average Annual (2017-2031)
<b>Premature Deaths Avoided, All Cause</b>			
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
<b>Reduced Morbidity Incidence</b>			
<b>Short-Term Ozone Exposure</b>			
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
<b>Long-Term PM2.5 Exposure</b>			
Acute Bronchitis	1,039	1,890	1,087
<b>Short-Term PM2.5 Exposure</b>			
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

# Monetize public health benefits

- Value of statistical life (VSL), based on willingness-to-pay (WTP) for a small health risk reduction



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

- Cost of illness (COI)**
  - Healthcare related costs
  - Time cost, e.g., missing work

# Estimated Public Health Benefits

- Based on reduced mortality and morbidity risks as a result of implementing proposed control measures
  - ✓ ~\$173 billion: present value of overall public health benefits from 2017-2031 in 4-county region
  - ✓ ~\$16.5 billion: average public health benefits per year
  - ✓ Over 95 percent associated with avoided premature deaths from reduced long-term exposure to PM<sub>2.5</sub>; the rest associated with reductions in other health risks.



# REMI Model

- SCAQMD uses a custom built regional economic impact model of the 4-county region based on 21 sub-county geographical units.
- The model simulates numerous macroeconomic variables including jobs, occupation, output, cost of production, and value-added by sector.
- The model's baseline employment and population forecast are updated based on those produced by SCAG (2016 RTP/SCS).



# REMI Modeling Assumptions

- Implementation of the 2016 AQMP imposes costs and generates benefits in the region.
- These costs and benefits will affect the economic decisions of producers and consumers in the region resulting in economic impacts.
- All these direct effects cascade through the regional economy and produce indirect and induced macroeconomic impacts.
- SCAQMD uses a regional economic impact model from REMI Inc. (PI+ v1.7) to simulate the impacts of the AQMP on the regional economy.

# Socioeconomic Analysis of Incentive Programs

- Partially or fully cover incremental costs,
- Part of total quantified costs
- Modeled:
  - (1) As if funded by state of California from existing revenue sources (i.e., no new tax and fees will be levied)
  - (2) As if funded by existing federal revenue (i.e., minimal impact to Southern California)

# Components of Macroeconomic Impacts

- Regional job impacts were simulated for incremental costs only, public health benefits only, and a combined scenario
- Other macroeconomic impacts were simulated for:
  - Job Impacts by occupational earnings group
  - Impacts of value added by sector
  - Impacts on relative cost of production by sector
  - Impacts on relative delivery prices by sector
  - Impacts on export and imports
- Regional job impacts from incremental costs were simulated for CEQA Alternatives
  - Alternative 2 (mobile source control measures only)
  - Alternative 3 (CARB and SCAQMD regulations only)
  - Alternative 4 (expanded incentive funding) TBD

# Incremental Cost and Incentives

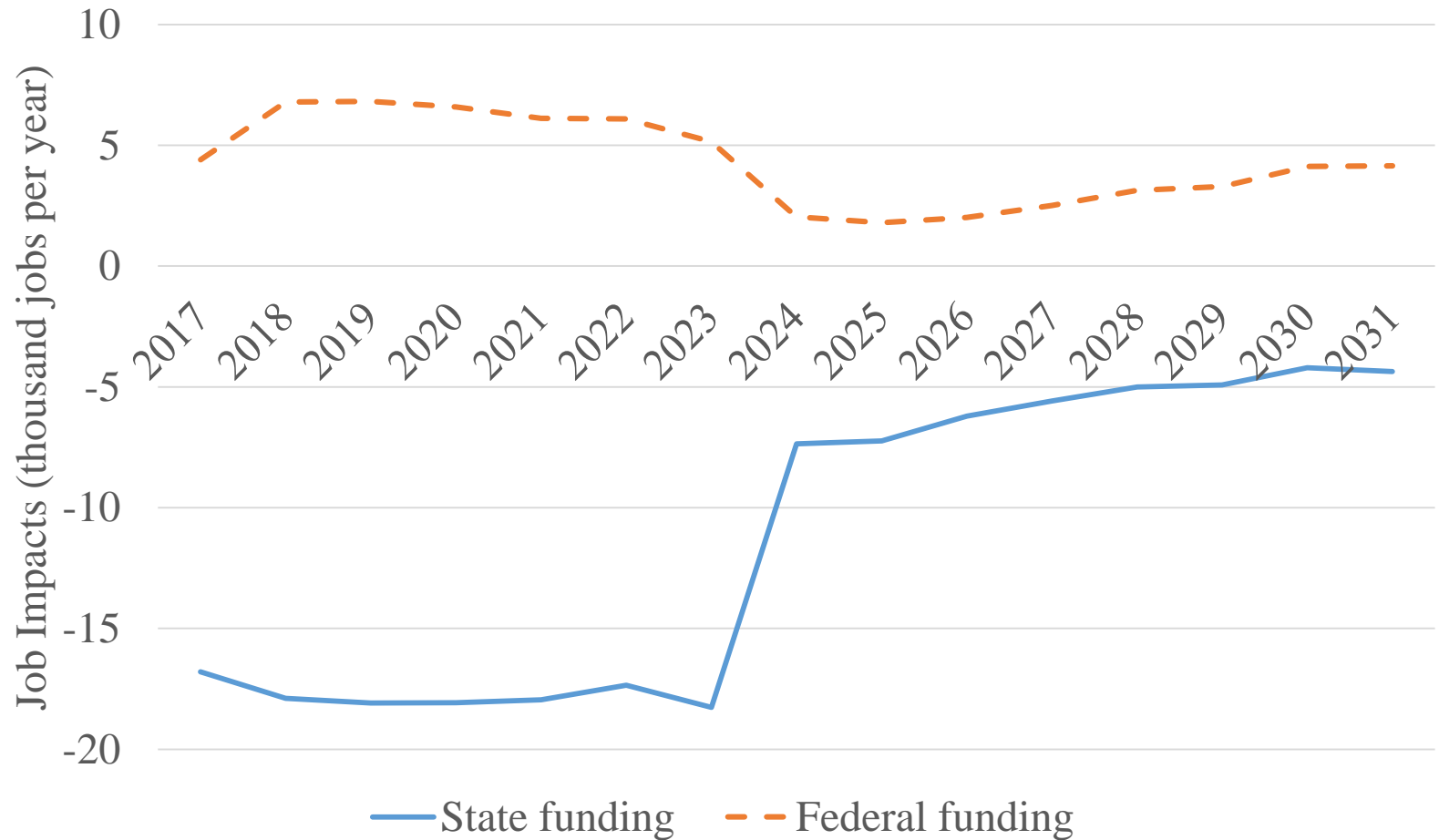
## REMI Modeling Assumptions

- Total incremental cost includes remaining incremental cost plus incentives
- Remaining incremental costs:
  - Industry: the production cost policy variable is used and associated spending is modeled with exogenous industry demand policy variable
  - Consumers: the consumer spending policy variable is used in conjunction with consumer spending reallocation to model impact on consumers.
- Government Incentives
  - All incentive programs will be funded by existing revenue sources for the state budget. This is modeled using the state government spending policy variable.
  - Results in state budget reallocation and affects provision of public services.
  - An additional incentive funding scenario is analyzed where funds are provided by the federal government.

# Modeling Incremental Costs (Mobile Sources)

Control Measure	Industries Incurring Incremental Costs/Savings	Supplier Industries Benefitting from Additional/Reduced Spending
ORHD-04 Advanced Clean Transit	Transit and ground passenger transportation	Chemical manufacturing
		Electrical equipment and appliance manufacturing
		Motor vehicles, bodies and trailers, and parts manufacturing
		Oil and gas extraction
		Utilities
ORHD-05 Last Mile Delivery	Couriers and messengers	Machinery manufacturing
	Truck transportation	
ORHD-09 Further Deployment: On-Road Heavy Duty	Truck transportation	Motor vehicles, bodies and trailers, and parts manufacturing

# Job Impacts from Alternative Funding Scenarios



# Public Health Benefits REMI Modeling Assumptions

- Public Health Benefits are valued using two general types of methodologies:
  - Willingness-to-pay (WTP) to reduce health risk
  - Avoided cost of illness (COI), direct and indirect.
- Benefits valued based on WTP are modeled using the non-pecuniary amenity aspects policy variable.
  - Increases attractiveness of the region relative to the rest of the nation, induces economic migration.
- Benefits valued primarily on avoided COI are modeled with:
  - Reduced consumer spending on healthcare-related goods and services.
  - Reallocation of consumer spending from healthcare to other goods, services, and savings.
  - Increased labor productivity for all industries.

# Job Impacts of Public Health Benefits

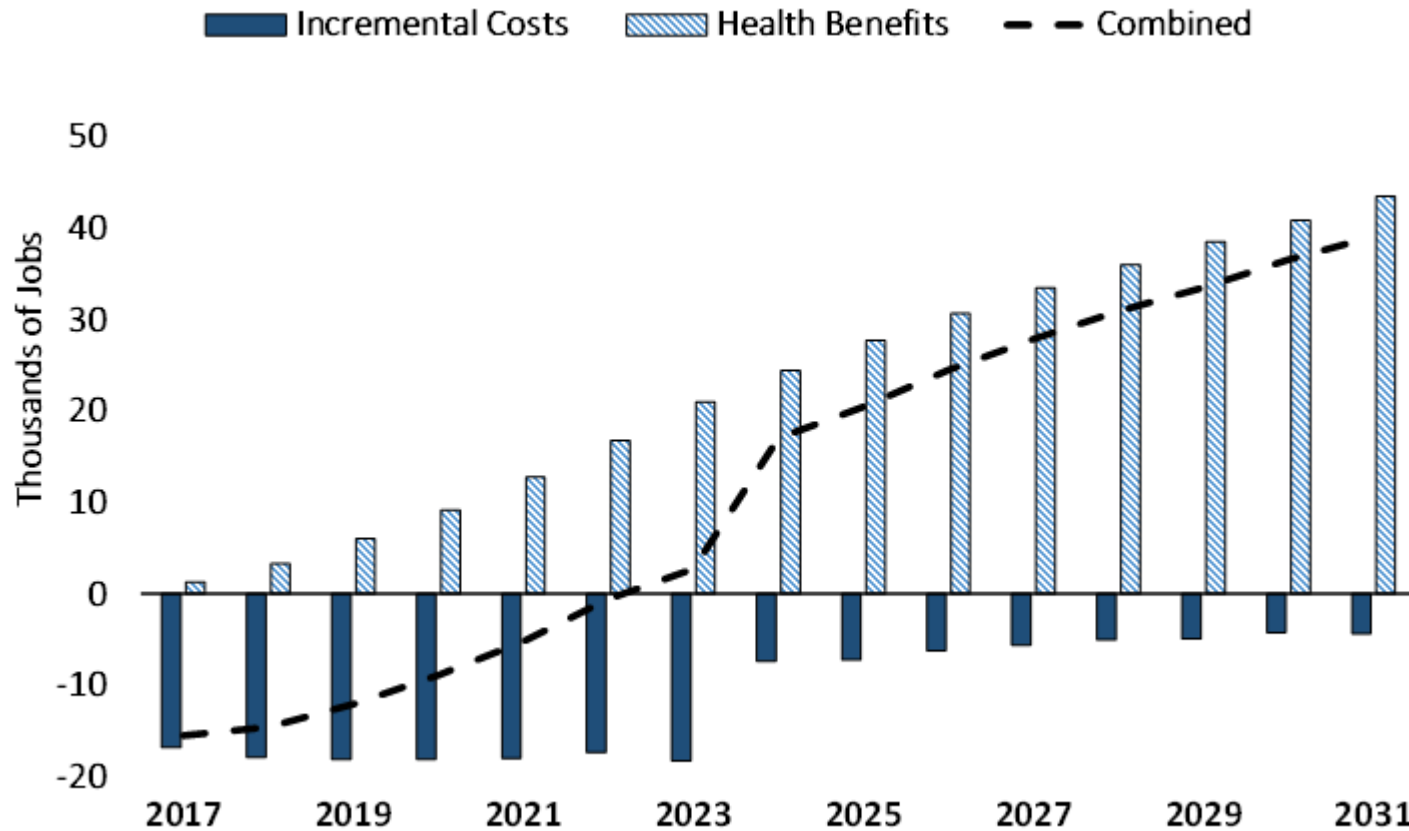
- Annual Job Impacts

	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%

- Job impacts are positive for all years and increase over time corresponding with health benefits.
- Mortality-related benefits contribute to the most job growth in the region.
- All public health benefits are projected to increase the number of jobs per year in the region by about 23,000 on average or 0.2% above baseline employment.
- Sectors which see the largest job growth are: Government, Construction, and Accommodation and Food Services.



# Overall Job Impacts



# Estimated Jobs Impact

	Health Benefits Included	No Health Benefits Included
Federal Revenues	<p><u>Best-Case Scenario:</u></p> <ul style="list-style-type: none"> <li>+29,000 jobs/year c.f. baseline</li> <li>1.04% annualized job growth (2016-2031)</li> </ul>	<ul style="list-style-type: none"> <li>+6,000 jobs/year c.f. baseline</li> <li>1.02% annualized job growth (2016-2031)</li> </ul>
State Revenues	<p><u>Primary Scenario:</u></p> <ul style="list-style-type: none"> <li>+14,000 jobs jobs/year c.f. baseline</li> <li>1.04% annualized job growth (2016-2031)</li> </ul>	<p><u>Worst-Case Scenario:</u></p> <ul style="list-style-type: none"> <li>-9,000 jobs jobs/year c.f. baseline</li> <li>1.01% annualized job growth (2016-2031)</li> </ul>

# Thank You Questions?



## Contacts:

Elaine Shen

[eshen@aqmd.gov](mailto:eshen@aqmd.gov)

Shah Dabirian

[sdabirian@aqmd.gov](mailto:sdabirian@aqmd.gov)

Anthony Oliver

[aoliver@aqmd.gov](mailto:aoliver@aqmd.gov)

## Link to Related Documents:

[http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/sociofinal\\_030817.pdf](http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/sociofinal_030817.pdf)

[http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/appfinal\\_030817.pdf](http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/appfinal_030817.pdf)

[http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/rtcfinal\\_02212017.pdf](http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/rtcfinal_02212017.pdf)

# Backup Slides



# ***Funding Sources (Examples)***

## **Expanding Existing Sources**

- Diesel Emissions Reduction Act (DERA), Air Shed Grants
- U.S. Department of Energy (Clean Cities Program)
- Carl Moyer Program
- Proposition 1B
- Low Carbon Transportation Funding (CARB)
- AB 118 – AQ Improvement Program/Fuel & Vehicle Technology Program
- AB 2766 – Local Governments
- SCAQMD Clean Fuels Fund

## **New Potential Sources**

- VW Settlement
- Future DERA Funding
- Cargo Container Fee
- Mileage-Based (VMT) User Fee
- Gas Sales Tax
- Public/Private Partnerships
- Expand DMV Registration Fees and Low Carbon Transportation Funding

# Legal Authority and Responsibility

## Federal

*(Aircraft, OGVs,  
Locomotives)*  
Reductions in  
State Strategy



## State

CARB SIP Strategy  
*(Mobile Source – On-  
Road Vehicles and Off-  
Road Equipment, and  
Consumer Products)*



## Regional

SCAQMD Stationary and  
Local Mobile Source  
Control Strategy

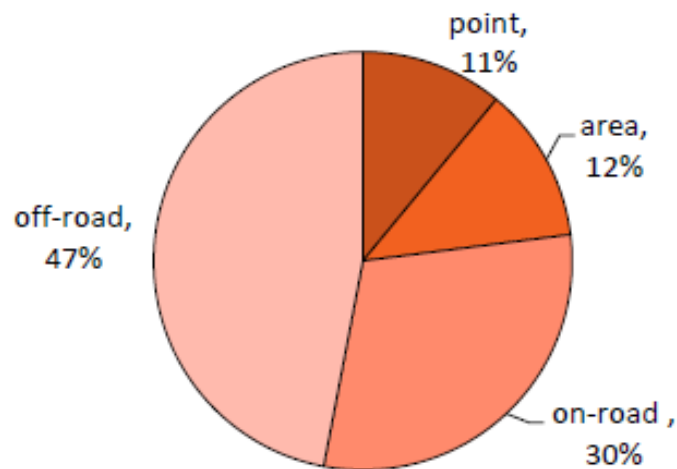
SCAG Regional  
Transportation Plan and  
Transportation Control  
Measures



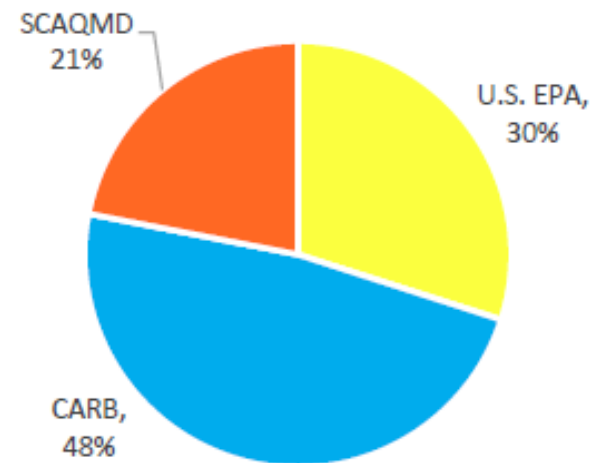
# California Health & Safety Code

- **Socioeconomic impact assessment:**
  - ❑ Type of affected industries, including small businesses
  - ❑ Impact on employment and the regional economy
  - ❑ Range of probable costs, including costs to industry or business
  - ❑ Availability and cost effectiveness of alternatives
  - ❑ Emission reduction potential
  - ❑ Necessity of adopting, amending or repealing rule/regulation to attain state and federal ambient air quality standards
- **Governing Board shall:**
  - ❑ Actively consider socioeconomic impacts
  - ❑ Make a good faith effort to minimize adverse socioeconomic impacts

# Relative Contribution by Source and Emission Inventory Agency Responsibility



**NOx Emissions: 214 tons/day**

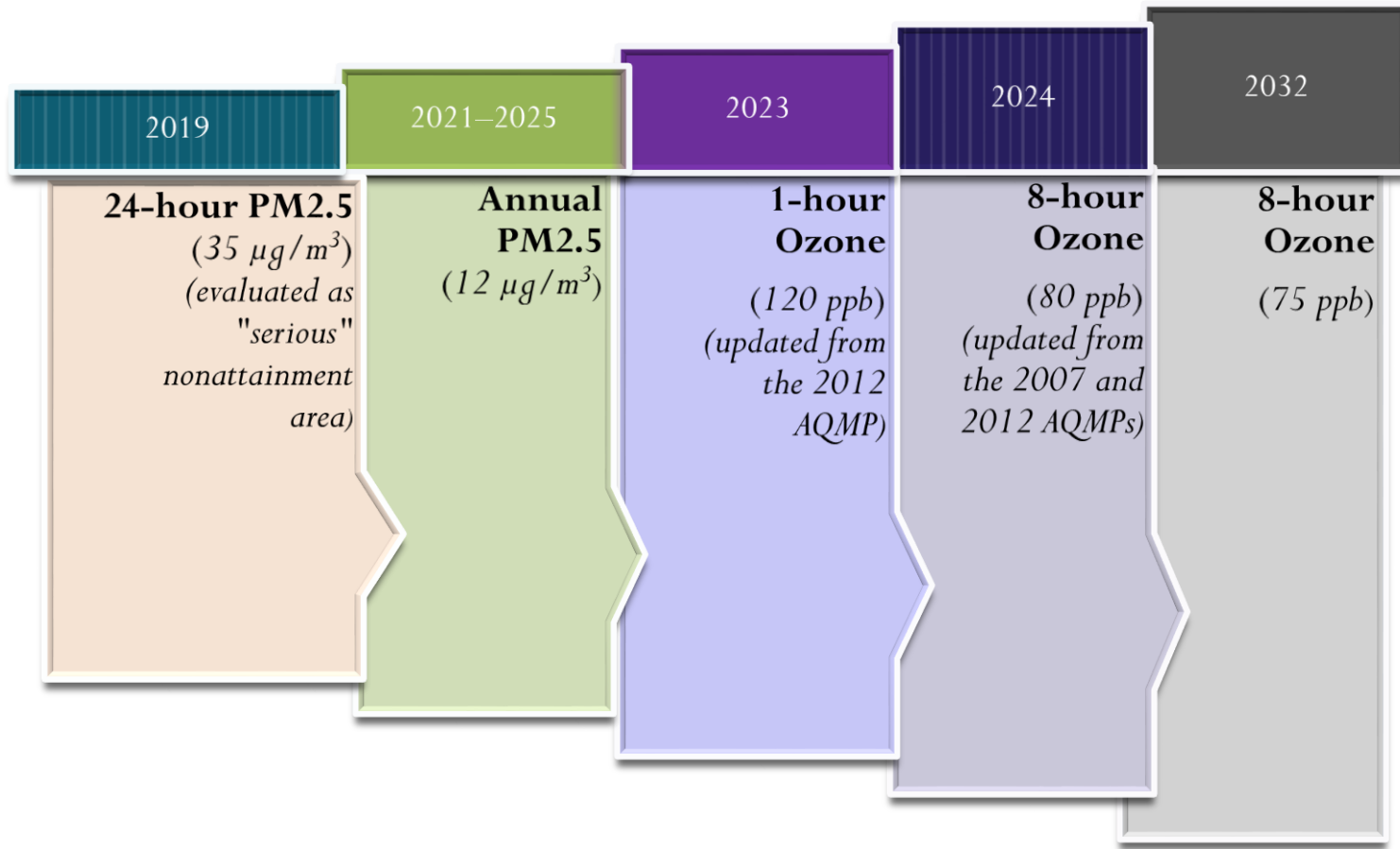


**NOx Emissions: 214 tons/day**

## 2031 NOx Emission Inventory

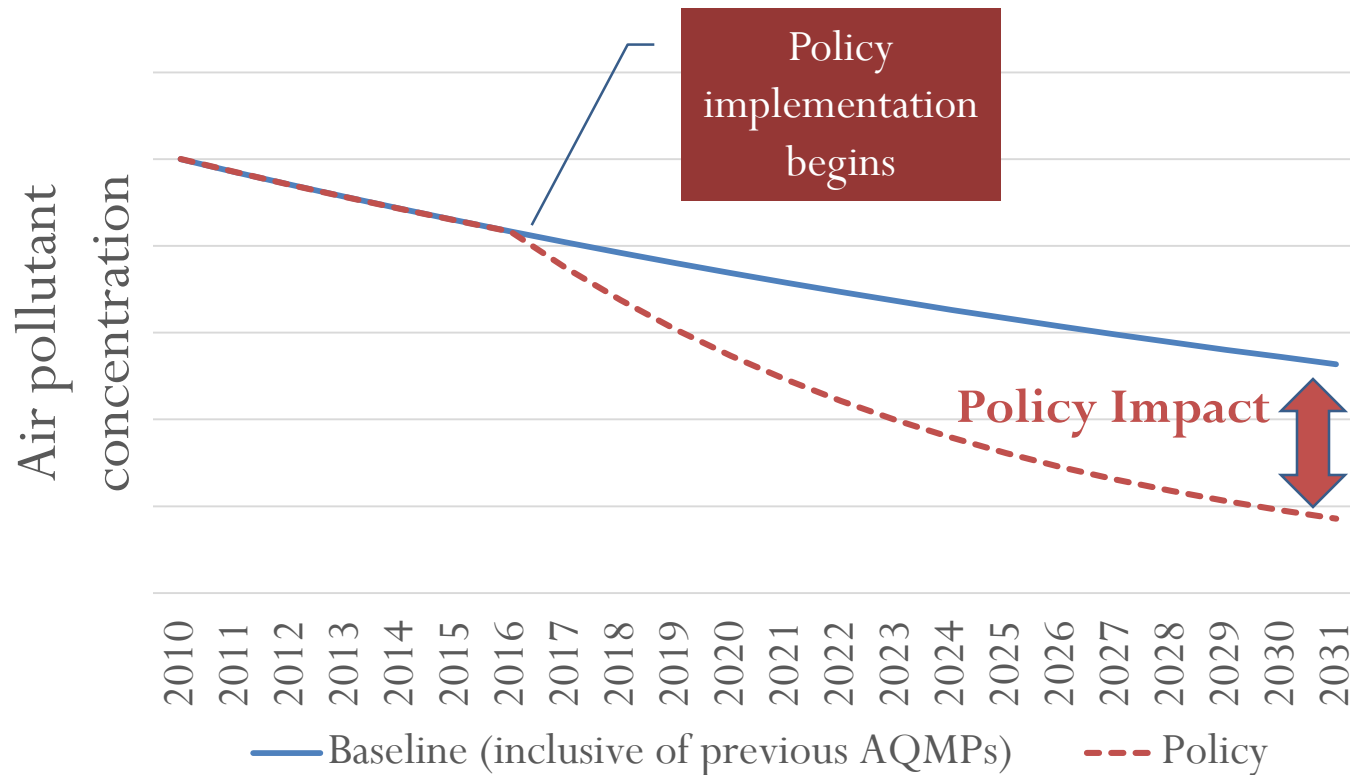


# 2016 Air Quality Management Plan Milestones and Standards



# Policy impact assessment

- **Difference between projected outcomes under policy and baseline scenarios**



# Incremental costs

- Cost/cost-savings otherwise would not occur *sans* Policy

## Illustrative Example



### A representative **conventional** model

- Capital Cost: \$20K
- O & M Cost: \$300/month

### A representative **lower-emission** model

- Capital Cost: \$50K
- O & M Cost: \$200/month

**Incremental Cost Per Unit** \*undiscounted

$$= (50K - 20K) + (200 - 300) \times \text{lifetime of equipment in months}$$

# Incremental Cost Compilation

## Mobile Source (Example)

### Advanced Clean Cars

Capital Cost Assumptions:

Equipment Name	Affected Industries (NAICS)	Per Unit/Facility Cost (\$)	Per Unit/Facility Incentive Amount (\$)	Number of Units	Years of Equipment Life
BEV(Battery Electric Vehicles)	Consumers	\$11,237	\$0	176,200	14
PHEV(Plug-in-Hybrid Electric Vehicles)	Consumers	\$10,676	\$0	392,100	14
FCEV(Fuel Cell/Battery Electric Vehicles)	Consumers	\$8,788	\$0	116,600	14

Additional annual operating savings

Years	Gasoline (Billions of Gallons)	Price of Gasoline (\$/Gallon)	Diesel (Billions of Gallons)	Price of Diesel (\$/Gallon)	Quantity of Electricity (MWhs)	Electricity Price (\$/MWh)	Quantity of Hydrogen (kg)	Price of Hydrogen (\$/kg)
2026	-0.022	\$3.29	-0.0002	\$3.54	77,000	\$137.9	1250,000	\$6.00
2027	-0.041	\$3.34	-0.0003	\$3.59	139,000	\$138.0	2410,000	\$6.00
2028	-0.057	\$3.41	-0.0004	\$3.67	189,000	\$137.4	3190,000	\$6.00
2029	-0.069	\$3.47	-0.0005	\$3.73	235,000	\$136.8	3950,000	\$6.00
2030	-0.079	\$3.52	-0.0006	\$3.78	267,000	\$136.8	450,0000	\$6.00
2031	-0.077	\$3.58	-0.0005	\$3.85	228,000	\$136.7	3,900,000	\$6.00

Control Measure	Present Value of Remaining Incremental Cost	Present Value of Incentives	Present Worth Value of Total Incremental Cost	Amortized Annual Average (2017-2031)
Advanced Clean Cars	(\$2,648.0)	+	\$0 = (\$2,648.0)	(\$90.8)

# Modeling Incremental Costs (Stationary Sources)

Control Measure	Industries Incurring Incremental Costs/Savings	Supplier Industries Benefitting from Additional/Reduced Spending
CMB-03 (Non-Ref Flares)	Ambulatory health care services	Chemical manufacturing
	Beverage and tobacco product manufacturing	
	Food manufacturing	
	Oil and gas extraction	
	Pipeline transportation	
	Utilities	
	Waste management and remediation services	
CMB-04 (Restaurant Burners)	Food services and drinking places	Machinery manufacturing

# Job Impacts of Incremental Cost Assumed State Funding

Sector	NAICS	Average Annual (2017-2031)		
		Jobs	Baseline Jobs	% Change
Agriculture, Forestry, Fishing, and Related Activities	11	-4	28,747	-0.01%
Mining	21	-141	26,073	-0.54%
Utilities	22	-254	25,739	-0.99%
Construction	23	-1,475	591,549	-0.25%
Manufacturing	33	1,277	662,486	0.19%
Wholesale Trade	42	40	489,248	0.01%
Retail Trade	44-45	-385	1,038,587	-0.04%
Transportation and Warehousing	48-49	315	383,908	0.08%
Information	51	-38	316,884	-0.01%
Finance and Insurance	52	-99	567,305	-0.02%
Real Estate and Rental and Leasing	53	-275	683,422	-0.04%
Professional, Scientific, and Technical Services	54	-493	899,580	-0.05%
Management of Companies and Enterprises	55	82	118,815	0.07%
Administrative and Waste Management Services	56	-22	865,447	0.00%
Educational Services	61	-95	250,443	-0.04%
Health Care and Social Assistance	62	-617	1,363,990	-0.05%
Arts, Entertainment, and Recreation	71	-44	347,599	-0.01%
Accommodation and Food Services	72	-672	751,627	-0.09%
Other Services, except Public Administration	81	-122	726,486	-0.02%
State and Local Government	n.a.	-6,274	1,030,886	-0.61%
<b>Total</b>		<b>-9,299</b>	<b>11,168,820</b>	<b>-0.08%</b>

# Over all Job Impacts by Industry

Sector	NAICS	Average Annual (2017-2031)		
		Jobs	Baseline Jobs	% Change
Agriculture, Forestry, Fishing, and Related Activities	11	2	28,747	0.01%
Mining	21	-126	26,073	-0.48%
Utilities	22	-182	25,739	-0.71%
Construction	23	573	591,549	0.10%
Manufacturing	33	2,017	662,486	0.30%
Wholesale Trade	42	691	489,248	0.14%
Retail Trade	44-45	1,995	1,038,587	0.19%
Transportation and Warehousing	48-49	685	383,908	0.18%
Information	51	154	316,884	0.05%
Finance and Insurance	52	301	567,305	0.05%
Real Estate and Rental and Leasing	53	1,378	683,422	0.20%
Professional, Scientific, and Technical Services	54	623	899,580	0.07%
Management of Companies and Enterprises	55	216	118,815	0.18%
Administrative and Waste Management Services	56	1,312	865,447	0.15%
Educational Services	61	487	250,443	0.19%
Health Care and Social Assistance	62	2,323	1,363,990	0.17%
Arts, Entertainment, and Recreation	71	166	347,599	0.05%
Accommodation and Food Services	72	2,212	751,627	0.29%
Other Services, except Public Administration	81	683	726,486	0.09%
State and Local Government	n.a.	-1,791	1,030,886	-0.17%
<b>Total</b>		13,720	11,168,820	0.12%