

Socioeconomic Impacts of South Coast AQMD Rule 1146.2

REMI User's Conference 2024



Agenda

South Coast AQMD Background

Rule 1146.2

Rule Costs

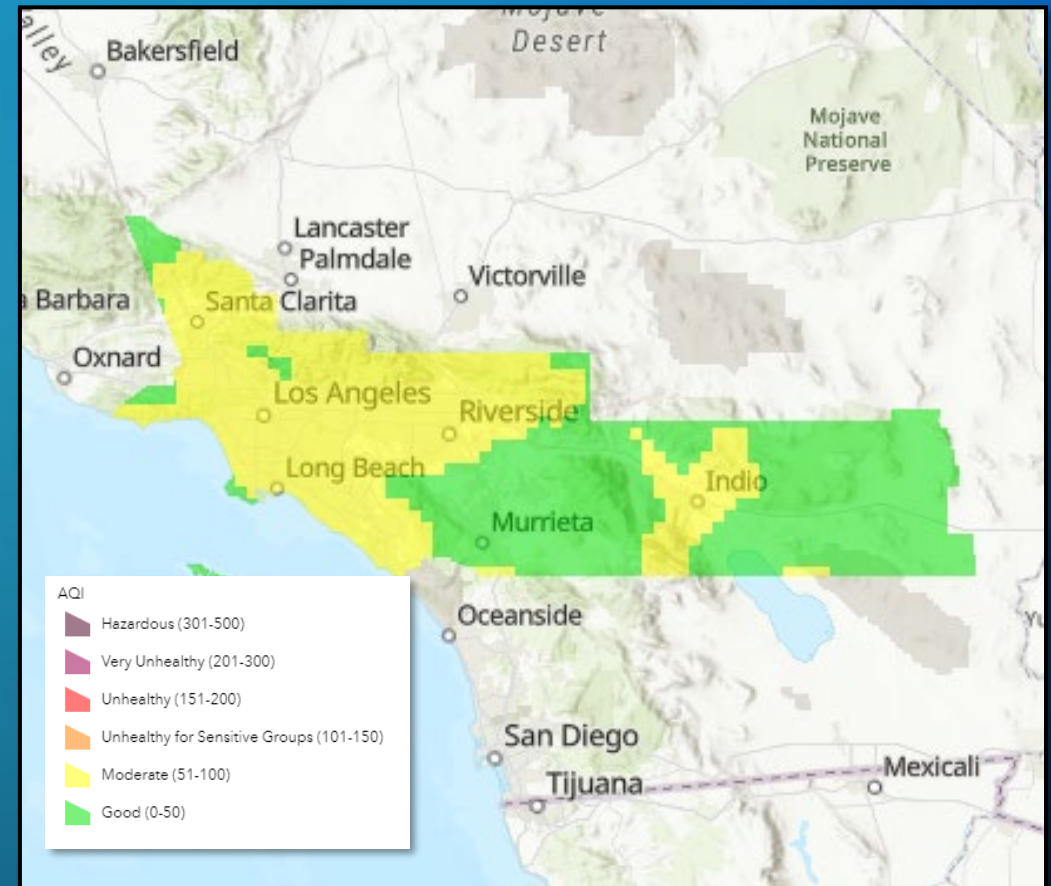
REMI Inputs

Results and Conclusions



South Coast AQMD Jurisdiction

- Regional air pollution control agency for Orange County and urban portions of Los Angeles, Riverside, and San Bernardino Counties
 - 17 million residents, over 10,000 square miles
- Primarily responsible for regulating emissions from stationary sources of air pollution
 - Refineries, power plants, gas stations, area sources, etc.



Regulatory Approach



Air Quality
Management
Plans (AQMP)



Regulations,
Incentives, and
Other Measures



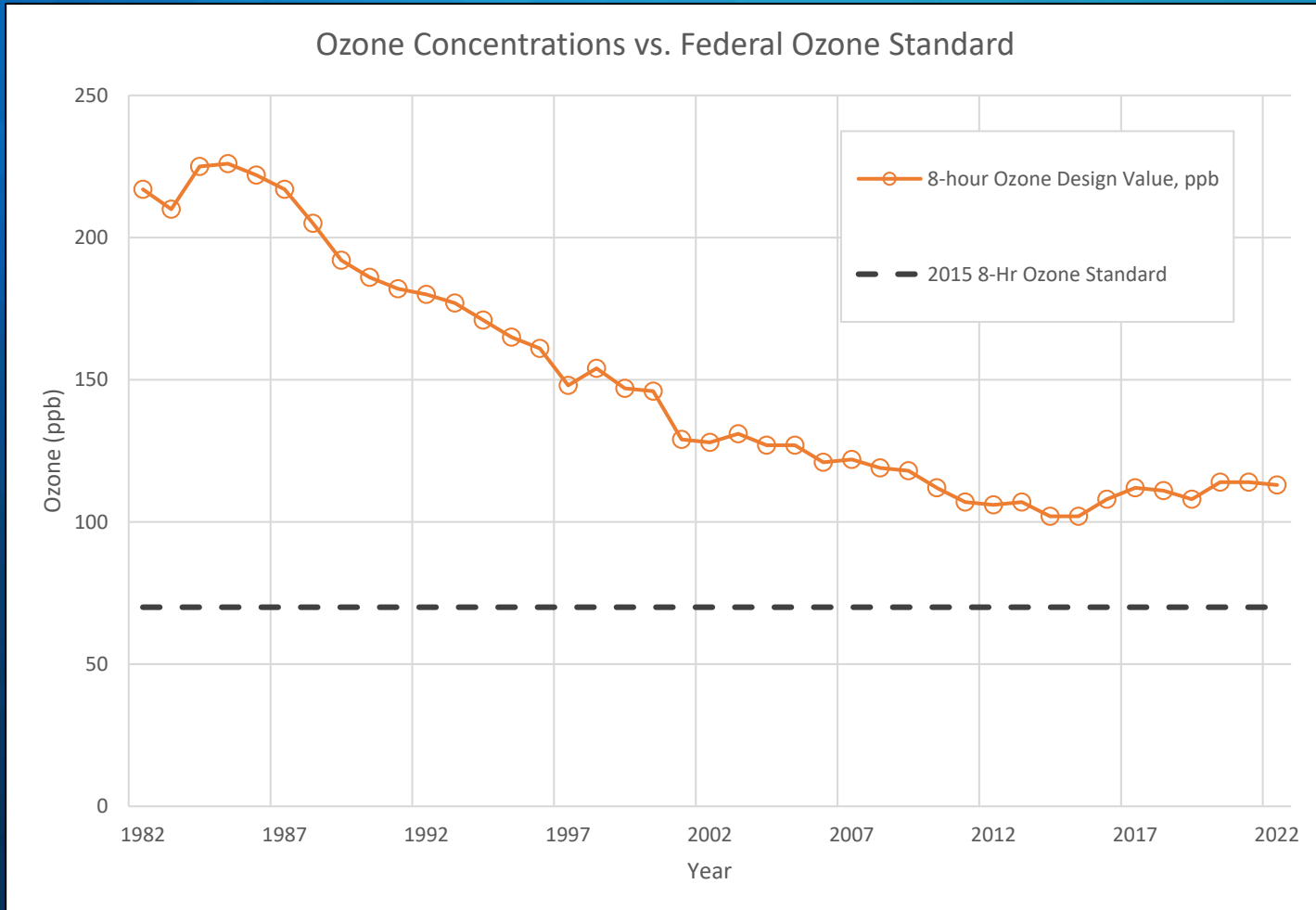
Permitting,
Outreach, and
Enforcement

Regional Air Quality



- South Coast Air Basin is in non-attainment for multiple federal standards:
 - Extreme non-attainment for ozone standards
 - Serious non-attainment for PM2.5 standards
- The region's unique topography and economic activity contribute to the poor air quality and make attainment of these standards challenging
- 2022 AQMP focuses on attainment of the 2015 federal 8-hour ozone standard by 2037
 - Oxides of Nitrogen (NO_x) are the primary precursor to both ozone and PM2.5
 - NO_x reduction measures are primary focus

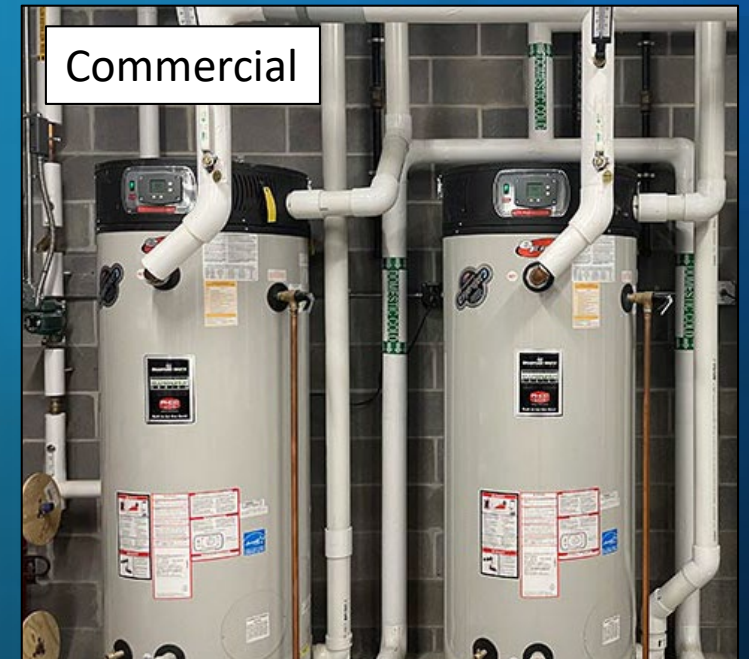
Air Quality Trends



- Despite dramatic improvements in air quality, challenges with attaining the federal standards remain
- Changing climate adds new challenges
- Further air quality improvements become incrementally more difficult
- Rules promoting zero-emission technologies necessary for additional NO_x reduction

Rule 1146.2 - Control of Oxides of Nitrogen from Large Water Heaters, Small Boilers and Process Heaters

- Limits NOx and carbon monoxide (CO) emissions from large natural gas-fired water heaters, boilers, process heaters, and residential tankless heaters and pool heaters
 - Establishes requirements for manufacturers, distributors, retailers, and installers
 - Affects over 1 million units



History of Rule 1146.2

Initially Adopted in 1998

- Previously amended in 2005, 2006, and 2018
- Previous amendments set standard of 14 ng/J of heat output (40 ng/J for pool heaters)

NOx emission limits progressively reduced over time as emission control technologies improve

- 2024 amendment set a zero-NOx emission limit
- Switch from natural gas to electric units at the end of useful life

Significant Emissions Reductions



5.6 Tons Per Day of NO_x
~10% of NO_x emissions regulated by
South Coast AQMD



Co-benefits of CO₂ Emission Reductions
Equivalent of removing ~1.2 million vehicles
from the road

Implementation of Rule 1146.2

- Rule 1146.2 established compliance deadlines, after which any new water heating units installed are required to be zero emission (ZE)
 - Effective dates vary from 2026 to 2033 based on equipment type, land use setting, and building age
 - Earlier implementation dates for more widely available units



Compliance Deadlines

New Buildings



Smaller Units: January 2026



Larger Units and Pool Heaters: January 2028



High Temperature Units: 2029

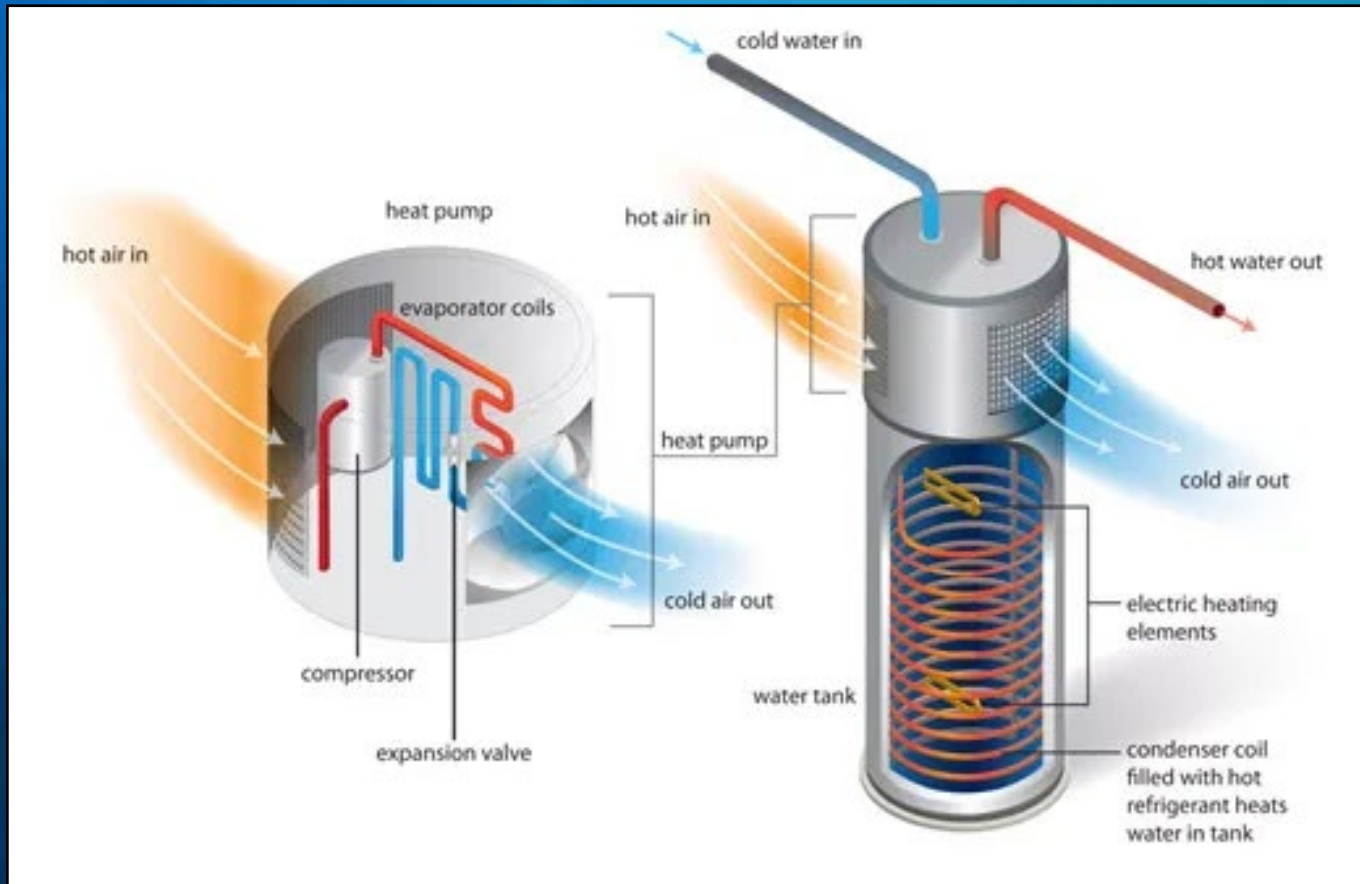
Existing Buildings

Smaller Units: January 2029

Larger Units and Pool Heaters: January 2031

High Temperature Units: January 2033

Zero-Emission Water Heaters



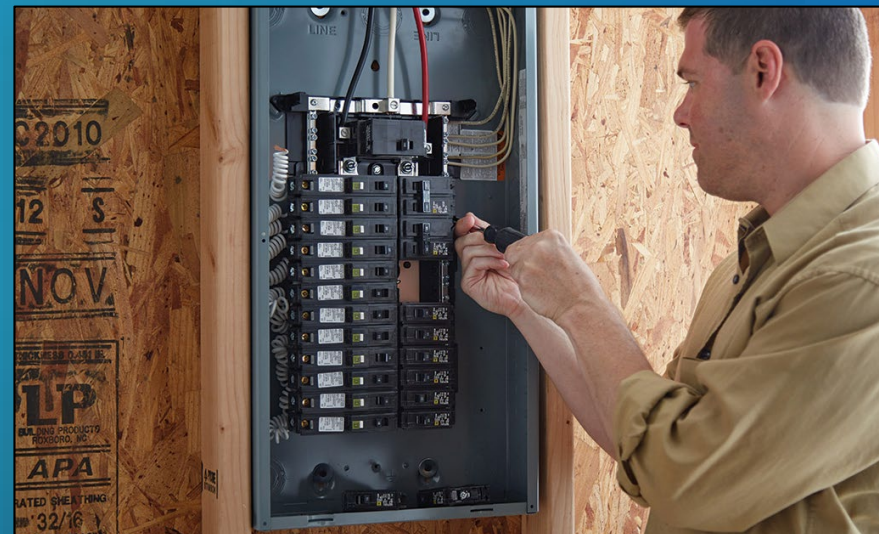
- Heat Pumps
 - Use heat from the ambient air to warm water
- More efficient than existing natural gas water heaters
 - Coefficient of performance (COP) of ~ 3.5 for heat pumps
 - Natural gas water heaters bounded at COP of 1

Incremental Capital Costs

Total Installed Cost (TIC) difference between heat pumps and natural gas units



Panel Upgrade Cost



$$TIC_{\text{incremental}} = (TIC_{\text{heat pump}} - TIC_{\text{natural gas}}) + \text{Panel Upgrade Cost}$$

Recurring Costs (Savings)

- Recurring energy costs
 - Price differential between natural gas and electricity costs
 - Based on price forecasts from California Energy Commission (CEC)
 - Estimated energy usage



$$\text{EnergyCost} = (\text{EnergyDemand}_{\text{HeatPump}} \times \text{ElectricityRate}) - (\text{EnergyDemand}_{\text{Gas}} \times \text{NaturalGasRate})$$

Example – Type 1 Commercial Water Heater

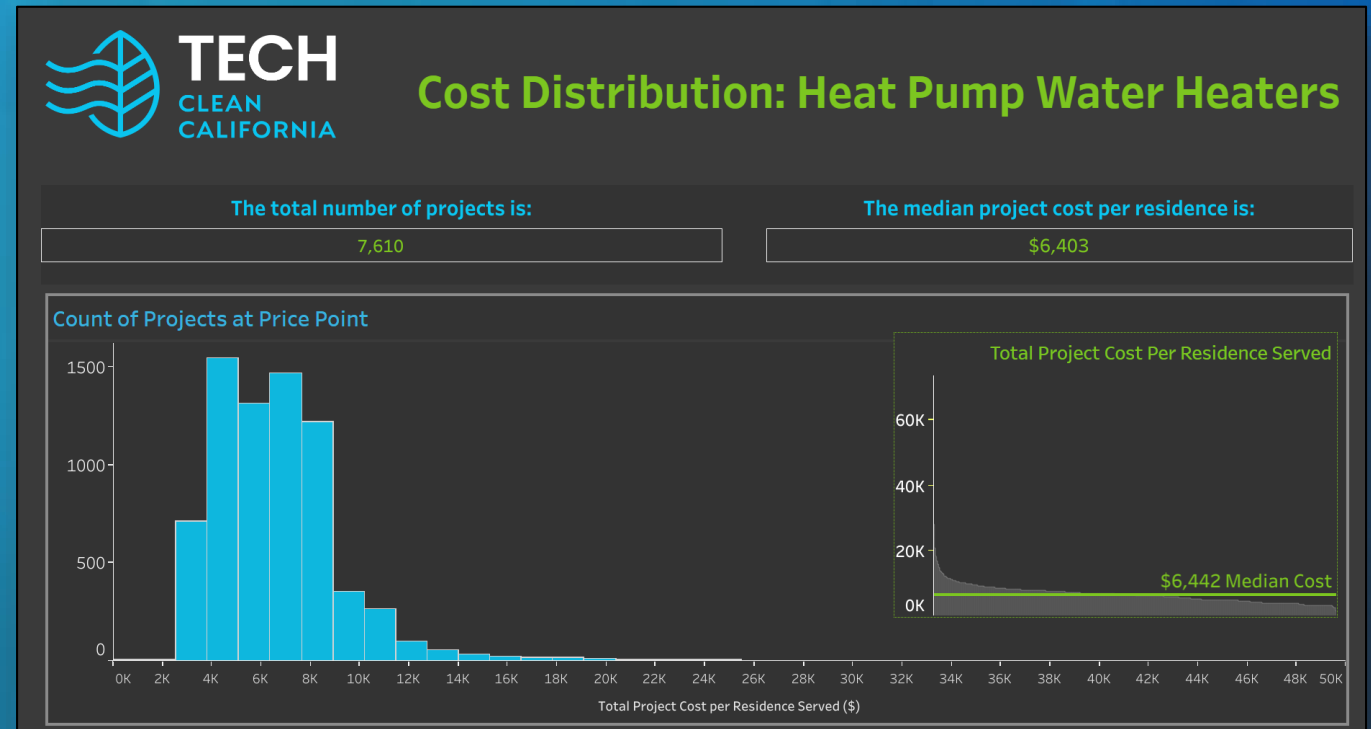
- Smaller, tank-type, low temperature units for commercial applications

Capital Costs	
Natural Gas Unit TIC	\$7,000
Comparable Heat Pump TIC	\$13,200
Panel Upgrade Cost	\$2,500
Total Incremental Cost	\$8,700

Recurring Costs	
Annual Natural Gas Demand	1,431 therms
Forecasted Natural Gas Rate	\$1.77/therm
Annual Electricity Demand	9,489 kWh
Forecasted Electricity Rate	\$0.26/kWh
Annual Incremental Savings	\$98

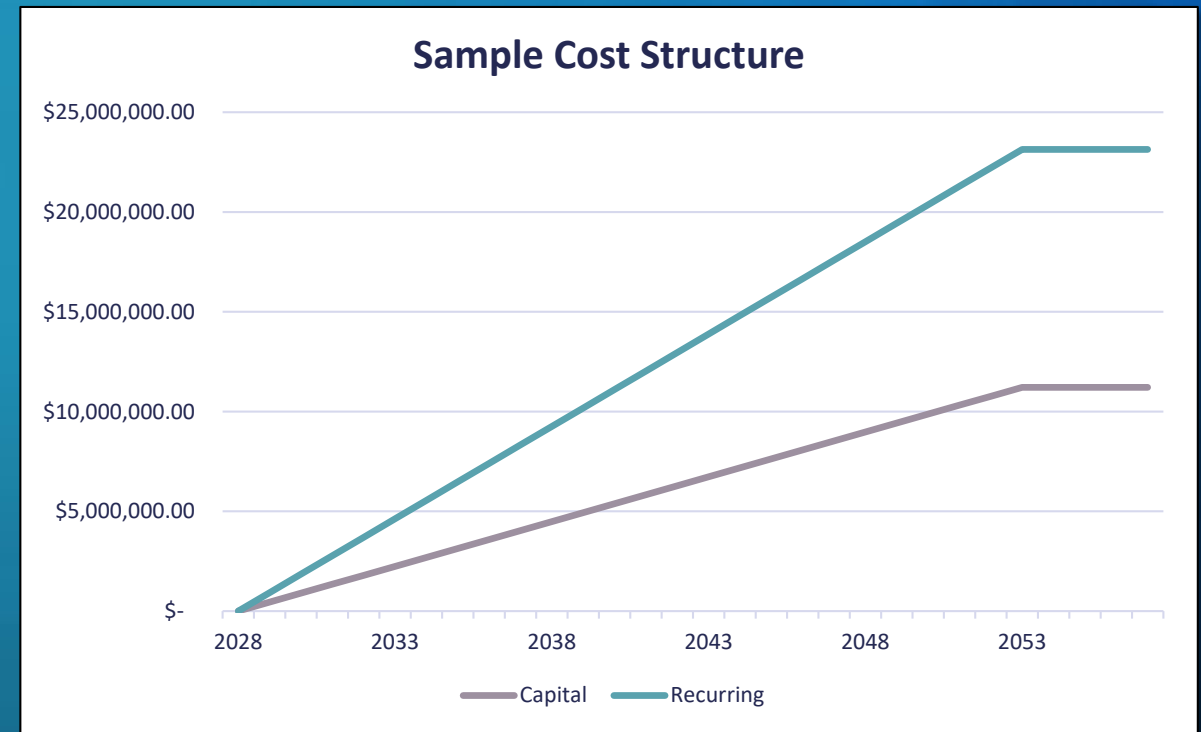
Data Sources

- Manufacturer quotes/surveys
- TECH Clean California
 - Heat pump incentive program
 - Data on equipment cost, install, panel upgrades, etc
- Department of Energy
- California Energy Commission
- Stakeholder feedback
 - Series of working group meetings



Modeling Assumptions - Costs

- 15- to 25-year useful life depending on equipment
- After compliance date, equal fraction of the total universe is replaced with a ZE unit every year until full implementation
 - Replacements evenly distributed over equipment lifetime
- Amortize capital costs over useful life at 4% real interest rate
- Recurring costs/savings increase proportionally with number of installed units



Total Costs

\$1.3 Billion
Present Value of
Compliance Costs

\$96.8 million
Average Annual
Compliance Cost

Cost Allocation



Residential

- Pool heaters
- Tankless water heaters

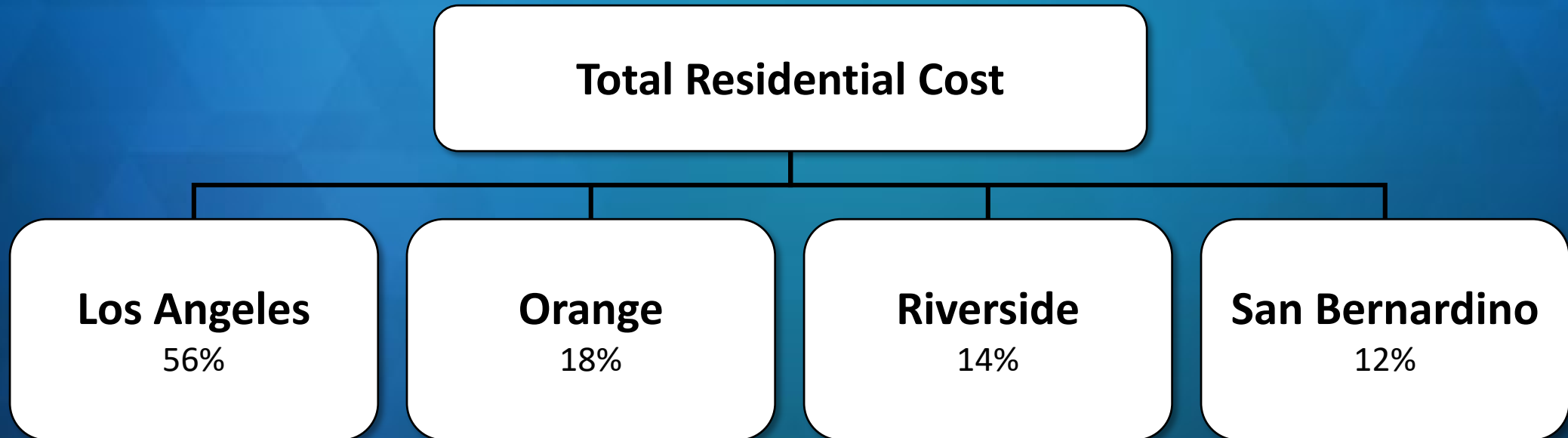


Commercial/Light Industrial

- Large water heaters
- Boilers

Residential Modeling Assumptions

- Increased costs are modeled in REMI as a decrease in discretionary spending
 - Assume compliance cost is fully offset by reduced consumer spending
- Allocate costs across four-county area based on population



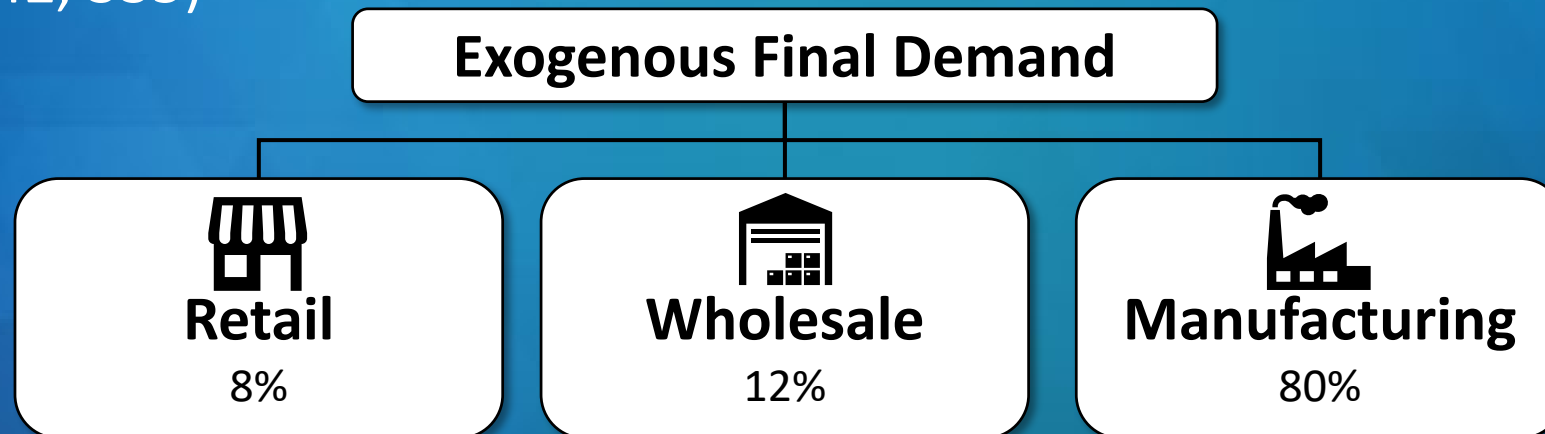
Commercial Modeling Assumptions

- Assume compliance costs are paid by building owners
 - All industries use some type of commercial real estate
- Proxy for cost using input/output matrix in REMI
 - Weight compliance costs for each industry based on the value of real estate used as input (NAICS 53)
 - Put simply, industries that have the highest real estate expenses will bear the highest costs relating to Rule 1146.2
 - For industry i in county c :

$$Weight_{ic} = \frac{Real\ Estate\ Input_{ic}}{Total\ Real\ Estate_c}$$

Revenue Modeling Assumptions

- Revenue from capital purchases is modeled as exogenous final demand in REMI
 - Split between installers retailers, wholesalers, and appliance manufacturers (NAICS 44-45, 42, 335)



- Incremental electricity costs accrue to the Utilities sector (22)
- Allocated across four-county area by population

REMI Policy Variables

Pool Heaters
Tankless Water Heaters
Electricity Costs

Consumer Spending

Commercial Heaters
Boilers
Electricity Costs

Cost of Production

Installers
Retailers
Wholesalers
Appliance Manufacturers
Utilities

Exogenous Final
Demand



4-county model customized
for South Coast AQMD

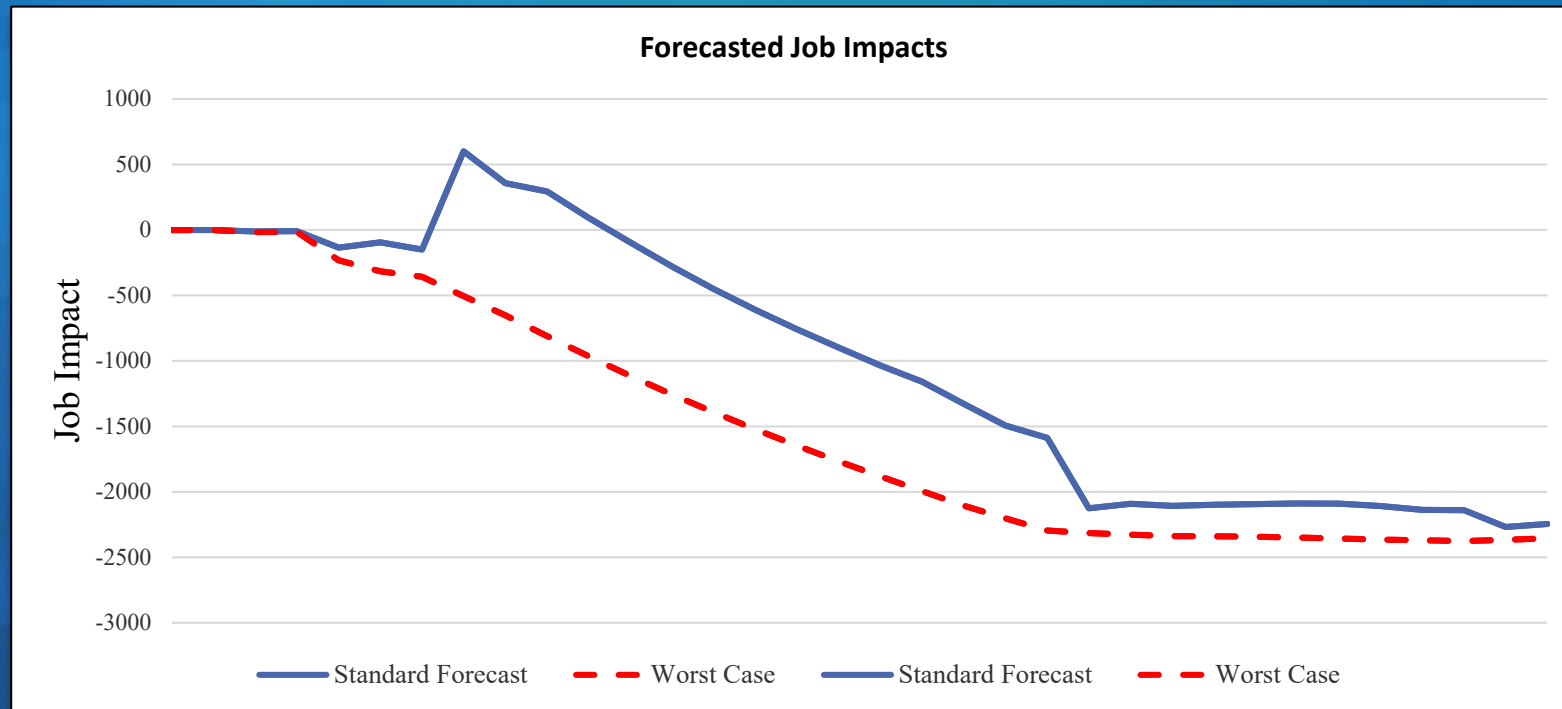
70 industrial sectors

Job Impacts

- Average of ~1,000 jobs foregone over the 2024 - 2057 forecast period relative to baseline forecast
 - <0.01% of employment in the region
- Negative job impacts in the construction, professional and scientific services, food service, and other industries
- Job gains in the manufacturing and metal fabrication industries

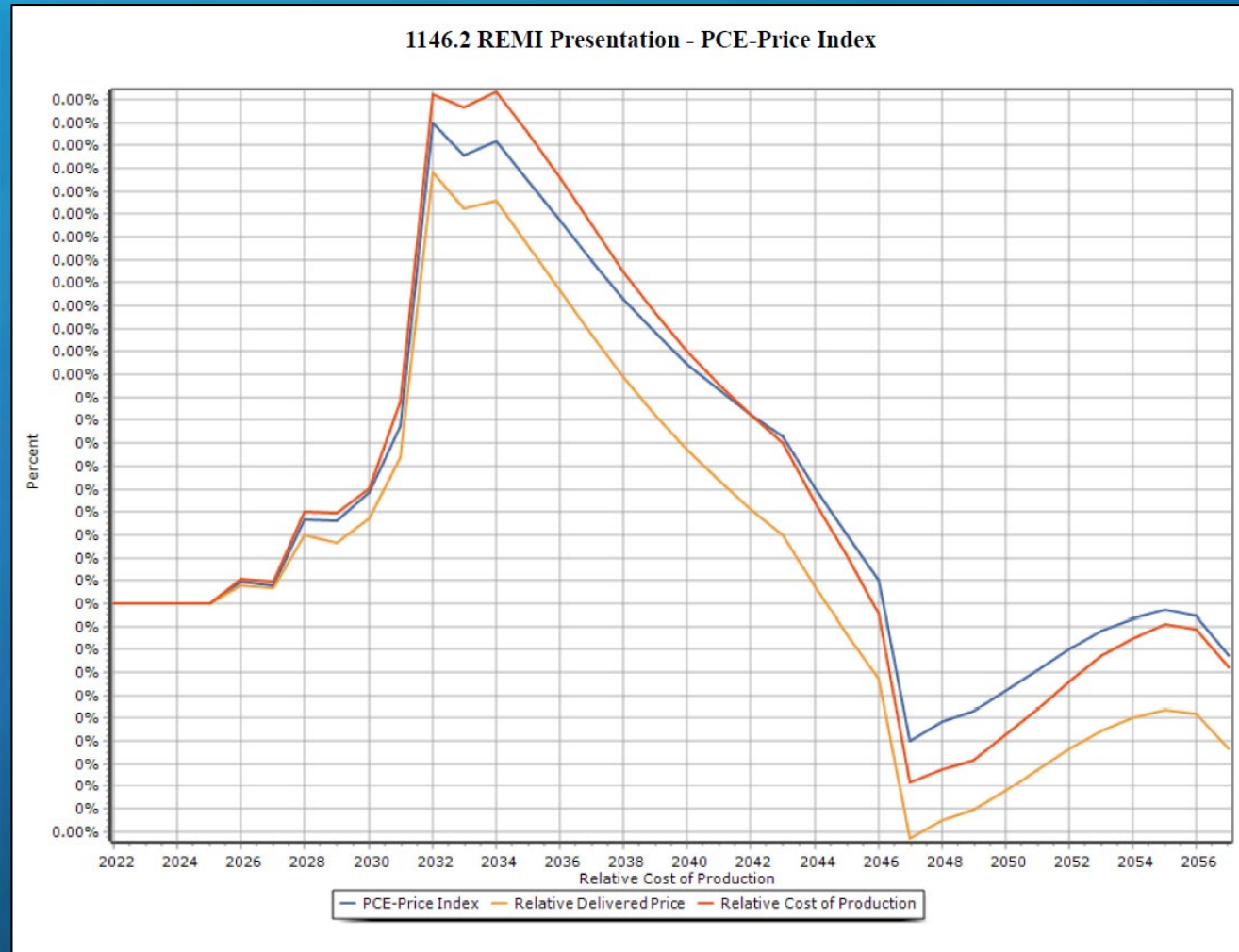
Job Impacts

- South Coast AQMD routinely models a standard forecast and a worst-case forecast
 - Test built-in assumptions about revenue earned inside or outside the region



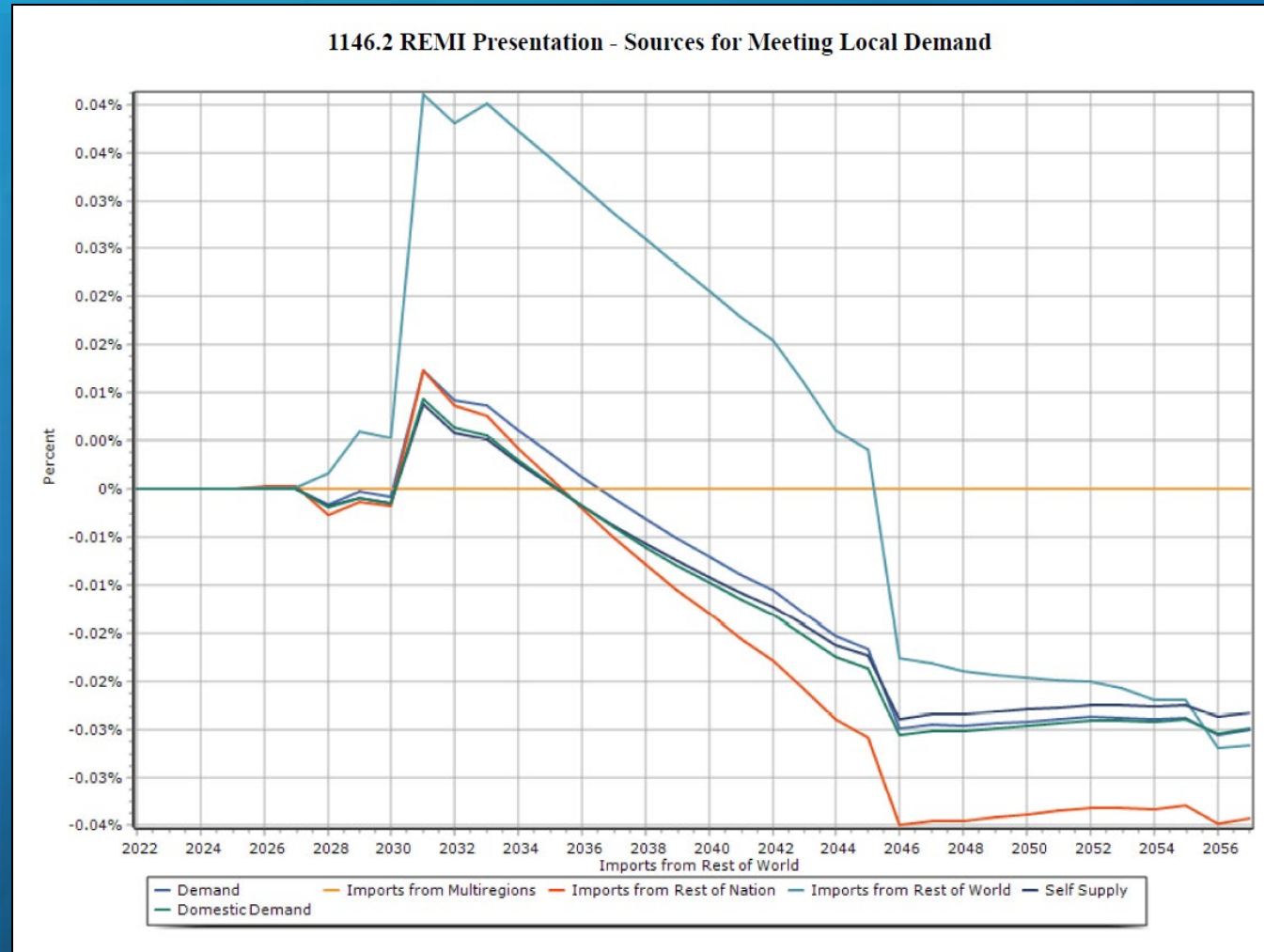
Other Outcomes – Price Level

- Small increase in prices
- Correction as savings accrue from greater efficiency gains in later years



Other Outcomes – Regional Imports

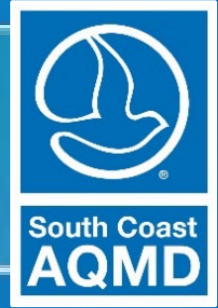
- Small increase in imports from outside the South Coast AQMD region
- Similar correction pattern in later years



Public Health Benefits

- Ozone and PM2.5 are known to cause premature death, asthma, hospital admissions for various diseases, and other negative health outcomes
 - Estimated monetized value of \$363,000 (2023 dollars) per ton of NOx reduced
- Full implementation of Rule 1146.2 is expected to yield 5.6 tons per day (2,044 tons per year) of NOx emission reductions
- Equivalent to \$740m in annual health benefits
 - Relative to \$96.8m in annual average costs

Questions



South Coast AQMD

Rule 1146.2



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