



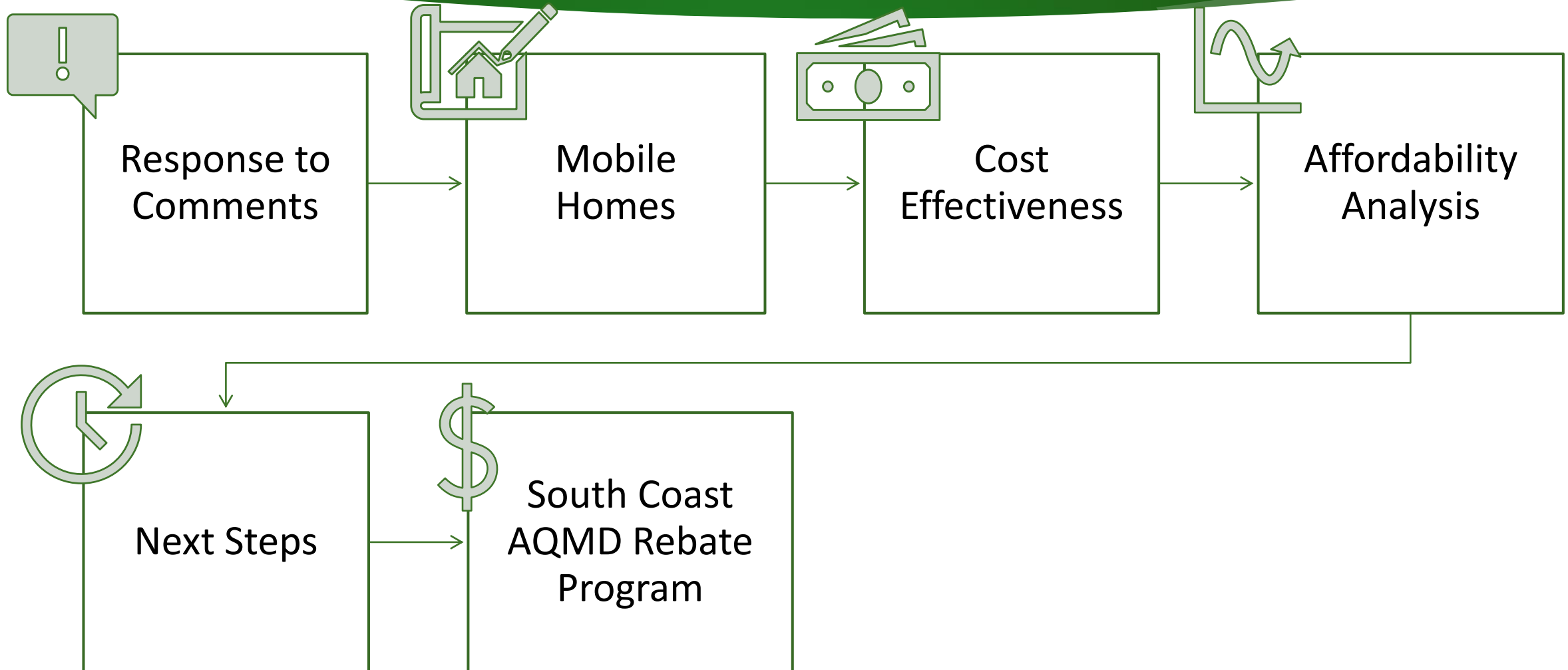
**Proposed Amended Rule 1111–
Reduction Of NO_x Emissions From Natural-
Gas-Fired, Fan-Type Central Furnaces**

**Proposed Amended Rule 1121–
Control of Nitrogen Oxides From Residential
Type, Natural Gas-Fired Water Heaters**

Working Group Meeting #3
January 31st, 2024, 1:00 PM (PST)

Join Zoom Meeting:
<https://scaqmd.zoom.us/j/97271436016>
Meeting ID: 972 7143 6016

Agenda



Summary of Working Group Meeting #2

In the previous Working Group Meeting, Staff provided background on:

Response to Comments

Data Sources

Cost Effectiveness Assumptions

Cost Effectiveness for Single Family Homes



Stakeholder Comments from Working Group Meeting #2

Response to Comments – NO_x from Furnaces

Comment:

- Furnaces only produce NO_x when cold (especially winter and nights) which is not when South Coast AQMD exceeds ozone standards

Response:

- NO_x produced at night remains present in the atmosphere and can form ozone during the day
- NO_x also forms PM_{2.5}, which is higher in the winter months
- South Coast Air Basin is currently in “serious” nonattainment of annual PM_{2.5} standard and will require further NO_x emissions to meet air quality standard, which is currently in “extreme” nonattainment

Mobile Homes



Background

- ▶ Approximately 1,400 mobile home parks in the South Coast AQMD
 - About 130,000 mobile homes (1/3 of California's total)
- ▶ Mobile home furnaces and water heaters are often smaller than appliances designed for single family homes
- ▶ 57% of mobile homes in California use natural gas as their main heating fuel*, this may be higher in South Coast AQMD region
- ▶ Many mobile home parks are “master-metered” with one electricity meter for the whole park
- ▶ 62% of mobile home households under \$90,000 income



*https://calnext.com/wp-content/uploads/2023/12/ET23SWE0017_Mobile-and-Manufactured-Housing-Market-Characterization-Study_Final-Report.pdf

Mobile Home Space and Water Heating

Space Heating

- ▶ Mobile home furnaces are smaller than typical gas furnace due to smaller size of mobile homes
 - Air handler for heat pump would need to fit in the furnace's space
- ▶ Mobile homes with air conditioning (AC) would not need electrical service upgrade for heat pumps, a heat pump draws similar or less electricity than an AC

Water Heating

- ▶ Many mobile homes come with small tank-type gas water heaters, current heat pump water heaters may not fit in the space
- ▶ May need panel upgrade if no empty circuits are available

Site Visit #1: Mobile Home in South Coast AQMD

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Home Characteristics

- Mobile home manufactured in 2009
- 100-amp panel, individual meter
 - Unused 30-amp breaker intended for electric dryer (gas dryer in place)

Current Space Heating

- 60,000 Btu furnace
 - 95% efficiency
- 2-3 ton AC



Possible Zero-NOx replacement

- Ducted Heat Pump
 - Can use existing AC electrical circuit



Site Visit #1: Mobile Home in South Coast AQMD

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Current Water Heating

- Tankless water heater, 199,000 Btu



Possible Zero-NOx Replacement

- 40 or 50-gallon heat pump water heater

- ▶ Water heater is installed in small blast proof closet
 - There are 40 or 50-gallon heat pump water heaters that can fit in the closet with a few inches' clearance
 - Small clearance and venting could make installation harder
 - Could also be installed in garage
 - Can use the breaker intended for electric dryer



Site Visit #2: Mobile Home Park

- ▶ Visited a mobile home park with approximately 300 mobile homes on 1/11/24
- ▶ Examined:
 - Mobile home built in late 1970s
 - Mobile home built in 1990s
 - Newly constructed mobile home
- ▶ Mobile home park required that all homes have central AC
- ▶ Homes are individually metered at 100 amps

Site Visit #2: Mobile Home Park - Takeaways

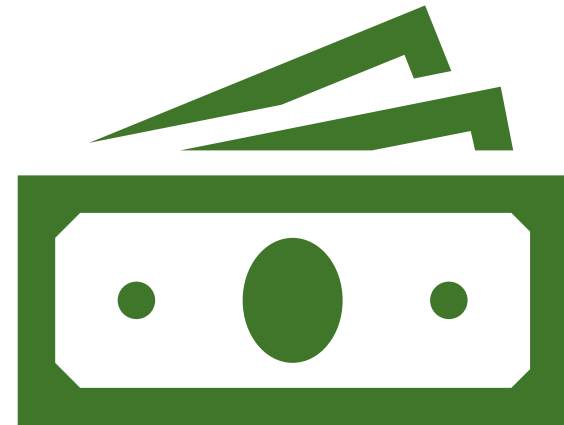
- ▶ Many models have water heater and furnace closets with exterior access
 - Most closets have enough room to accommodate heat pumps
- ▶ Mobile homes in the park can replace furnace and AC with ducted heat pump
- ▶ Heat pump water heaters can also be installed, but may require some electrical work
- ▶ Park prefers to replace older mobile homes with new homes that have better insulation and energy efficient appliances



Summary

- ▶ HVAC heat pumps are feasible for mobile homes
- ▶ There are more challenges for heat pump water heaters in mobile homes
 - More electrical work
 - Additional costs
- ▶ Mobile homeowners are less motivated to install zero-emission appliances
 - Lower income
 - Master metering provides disincentive to upgrade appliances
 - Mobile homes subject to HUD building standards and additional standards by the park
- ▶ More incentives may be required to increase adoption of zero-emission appliances

Cost Effectiveness



Cost Effectiveness Recap

Heat Pump Installation Costs:

- Staff used data collected from the TECH Clean California (TECH) rebate program to determine average costs of heat pump installations in our region
 - TECH is a statewide initiative to accelerate the adoption of clean space and water heating technology across California homes
 - TECH compiles heat pump installation costs in a publicly available database which is updated as more rebates are claimed

Gas Appliance Installation Costs:

- Averages costs of gas appliances are from E3's 2019 Residential Building Study
 - E3 study also has estimates of units installed for low rise multifamily units

Updates to Single Family Cost Effectiveness

- ▶ Updated TECH data from August to November data release
 - Heat Pump HVAC Average Costs: **\$17,900 → \$18,500**
 - Heat Pump Water Heater Average Costs: **\$5,900 → \$5,700**
- ▶ Heat pump HVAC less cost-effective, heat pump water heaters (HPWHs) slightly more cost-effective

Category	Cost Effectiveness	Cost Effectiveness (Panel Upgrade Shared)
Heat Pump HVAC		
No Incentives	(\$154,000) \$49,000	(\$165,000) \$38,000
IRA Incentive	(\$800,000) (\$597,000)	(\$811,000) (\$608,000)
TECH Incentive	(\$477,000) (\$274,000)	(\$488,000) (\$285,000)
Both Incentives	(\$1,124,000) (\$921,000)	(\$1,134,000) (\$931,000)
Heat Pump Water Heaters		
No Incentives	\$854,000 \$789,000	\$833,000 \$768,000
IRA Incentive	\$320,000 \$274,000	\$299,000 \$253,000
TECH Incentive	(\$84,000) (\$149,000)	(\$105,000) (\$170,000)
Both Incentives	(\$618,000) (\$664,000)	(\$639,000) (\$685,000)

Cost Effectiveness – Multifamily

- ▶ Used TECH Clean California Multifamily data set
 - Multifamily dataset is much smaller than single family, under 1,400 entries versus over 18,000
- ▶ Compared to multifamily gas unit installation costs from E3 2019 Residential Building Study

TECH Multifamily Cost Data

- Heat Pump HVAC: **\$5,300**
- Heat Pump Water Heater: **\$4,300**

E3 Multifamily Cost Data

- Gas Furnace and AC: **\$12,400**
- Gas Furnace Only: **\$6,600**
- Gas Water Heater: **\$2,700**

Cost Effectiveness – Multifamily Space Heating

- ▶ Cost for heat pumps installed in apartments significantly lower than single family data
 - Economy of scale for multiple installations,
 - Cost savings from one heat pump serving multiple apartments

Category	Additional Cost (Replacing AC and furnace)	Additional Cost (Replacing furnace)	Cost Effectiveness (Weighted Average)	Cost Effectiveness - Panel Upgrade Shared with Water Heater (Weighted Average)
No Incentives	-\$7,100	-\$1,300	(\$2,272,000)	(\$2,283,000)
With IRA Tax Credit	-\$8,700	-\$2,900	(\$2,279,000)	(\$2,801,000)
With TECH Incentive	-\$8,100	-\$2,300	(\$2,595,000)	(\$2,606,000)
Both Incentives	-\$9,700	-\$3,900	(\$3,113,000)	(\$3,124,000)

Cost Effectiveness – Multifamily Water Heating

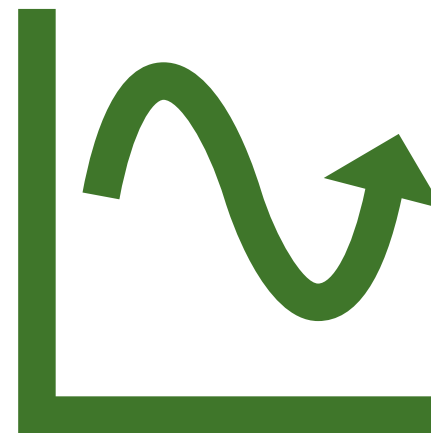
- ▶ Costs similar to single family heat pump water heaters
- ▶ Like single family, multifamily water heating is over the screening threshold with no incentives

Category	Additional Cost	Cost Effectiveness	Cost Effectiveness (Panel Upgrade Shared with HVAC)
No Incentives	\$1,300	\$404,000	\$424,000
With IRA Tax Credit	\$60	\$17,000	\$38,000
With TECH Incentive	-\$1,700	(\$534,000)	(\$513,000)
Both Incentives	-\$3,000	(\$921,000)	(\$900,000)

Summary

- ▶ Single family updates to TECH data: slight changes to cost effectiveness, no changes above or below screening threshold
- ▶ Based on current assessment of multifamily units: water heating with no incentives is somewhat over screening threshold, all other categories under the threshold
 - Note: screening threshold is neither considered a starting point for control costs, nor an absolute cap

Affordability Analysis



Affordability Analysis

- ▶ Staff recognizes cost effectiveness of some categories, especially water heaters is high
 - Affordability analysis is intended to show the economic impact on households
- ▶ Similar approach to the Socioeconomic Impact Analysis the Bay Area AQMD performed for Rules 9-4 and 9-6

Data Sources



American Community Survey

- Administered by the U.S. Census
- Has information on household income and poverty levels at county level



Consumer Expenditure Survey

- Administered by U.S. Bureau of Labor Statistics
- Includes information on household expenses by type
- National average



Income Limit Dataset

- Created by Department of Housing and Urban Development (HUD)
- Sets low-income limits for participation in HUD programs (separate from federal poverty line)

Low Income Limits

- ▶ Low Income limits for household calculated by HUD as high as \$108,000 in South Coast AQMD region
- ▶ Median rents and housing costs can be used to gauge impact of heat pump costs

Category	Los Angeles County	Orange County	Riverside County	San Bernardino County
HUD Low Income Limit	\$95,000	\$108,000	\$70,000	\$70,000
Percent of households below limit	46%	47%	28%	30%
Monthly Median Housing Costs	\$1,900	\$2,300	\$1,800	\$1,600
Monthly Median Rent	\$1,800	\$2,200	\$1,700	\$1,600

Estimating Lifetime Unit Costs

Present Value Factor (PVF)

Used to calculate the present value of a future sum of money

Acts as a multiplier to convert future cash flows into today's dollars

$$PVF = \frac{(1 + r)^N - 1}{r * (1 + r)^N}$$

- r = real interest rate (discount rate, 4%)
- N = years of equipment life
- ▶ 15-year lifetime gives a PVF of 11.118 for space and water heaters
- ▶ Staff used the 15-year PVF to estimate the lifetime incremental cost to install a heat pump instead of a gas combustion units

Annual Costs for Heat Pumps – Single Family

- ▶ Table below shows total lifetime incremental costs to switch to heat pump HVAC and water heating
- ▶ Incremental HVAC and water heating costs are combined then divided by present value factor of 11.118 to determine the annualized costs

Type	HVAC Costs	Water Heating Costs	Total Combined Lifetime Incremental Costs	Annualized Costs
Homes with Pre-Existing AC				
No Incentive	-\$1,056	\$2,468	\$1,412	\$127
TECH Incentive	-\$2,056	-\$631	-\$2,687	-\$241
TECH Incentive and IRA Credit	-\$4,056	-\$2,332	-\$6,389	-\$574
Homes with No Pre-Existing AC				
No Incentive	\$7,731	\$2,468	\$10,200	\$917
TECH Incentive	\$6,731	-\$631	\$6,100	\$549
TECH Incentive and IRA Credit	\$4,731	-\$2,332	\$2,398	\$215

Zero-Emission Affordability Comparison

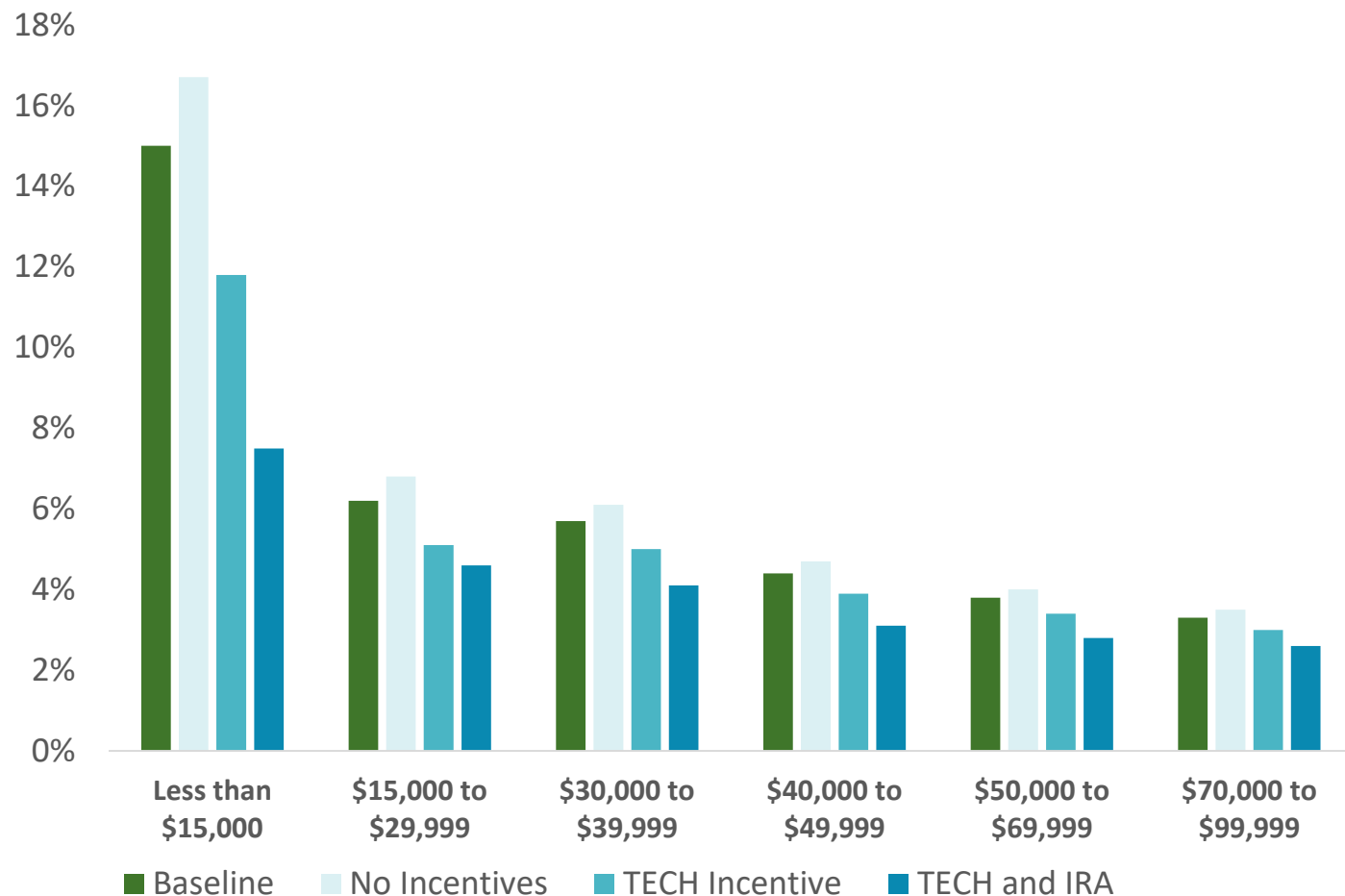
Compare annualized costs of heat pumps to typical annual appliance expenses at different income levels

Differences in expenses can show how big an impact the zero-emission regulations would have on household budgets

Staff used data from the Consumer Expenditure Survey to estimate percent of household income currently being spent on appliances and the impact of switching to zero-emission appliances

Homes with Pre-Existing AC

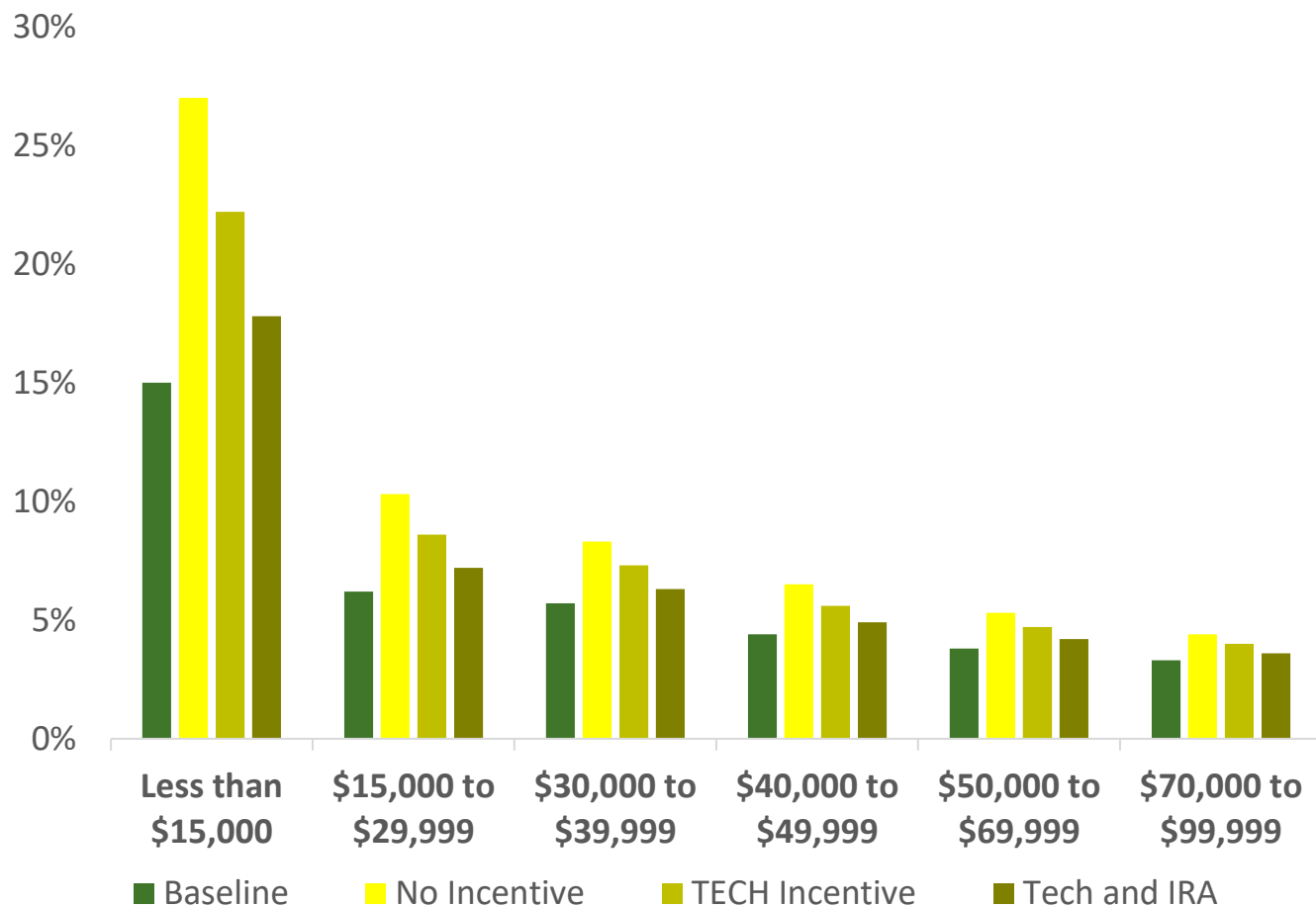
Appliance Expenses (Percent of Income)



- ▶ Baseline shows estimated percent of household income currently spent on household appliances
- ▶ Examining how heat pumps would increase or decrease household appliance expenses for different income levels
- ▶ All income levels in graph are below one of the HUD low-income limits for the four counties
- ▶ For incomes above \$15,000, annual additional cost with no incentives to switch to heat pumps is less than 1% of income

Homes without Pre-Existing AC

Appliance Expenses (Percent of Income)



- ▶ Baseline shows estimated percent of household income currently spent on household appliances
- ▶ For incomes below \$15,000, annual cost increase is up to 12% of household income
 - 8.5% of households in South Coast AQMD
- ▶ For incomes above \$50,000, annual cost increase is less than 1% of annual income
 - 70.6% of households in South Coast AQMD

Summary

- ▶ Additional costs to install zero-emission appliances instead of conventional appliances for all households with pre-existing AC is less than 2% of annual income
 - 87% of households in South Coast AQMD have AC
- ▶ Impacts are highest for households with no pre-existing AC and households in the lowest income bracket, up to 12% of income
 - Costs used are average heat pump installation costs, cheaper alternatives are available
 - Low-income households may be in multi-family rental units
 - Lower installation cost per unit according to TECH data
 - Not directly impacted as property owner would be responsible for appliance costs; however, property owner might pass the cost to the tenants
 - Upcoming IRA rebates and South Coast AQMD rebate program are focused on lower income and may cover significant portion of incremental cost
- ▶ Costs may lower as adoption increases and technology matures

Staff Recommendations

The 2022 Air Quality Management Plan called for zero-emission standard to be implemented by 2029

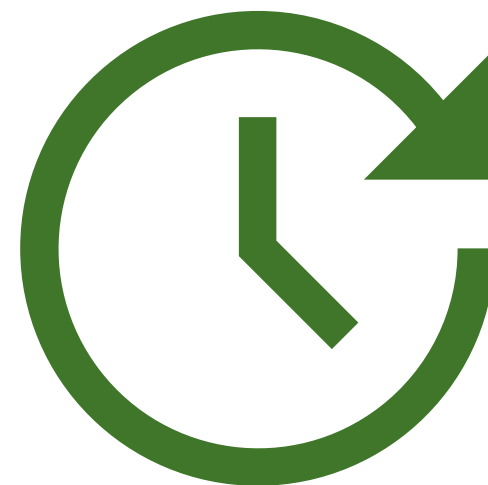
Best Available Retrofit Control Technology analysis shows a residential space and water heating zero-emission standard is feasible

- Cost effectiveness of water heating is high, but affordable for most households
- Cost of zero-emission technology is expected to drop in the future

Staff proposes zero-emissions standard for space and water heating in 2029

- Still considering feasibility of zero-emission standard for mobile homes and other applications

Next Steps



Next Steps

Examine other previously unregulated categories

- Commercial Space Heating, Wall and Floor Residential Heaters

Continue Working Group Meetings

Conduct site visits and hold stakeholder meetings

Develop pilot rebate program to incentivize early transition to zero emission technologies with anticipated launch summer 2024

Anticipated Public Hearing: 4th Quarter 2024

Sign Up for Notifications

- To receive newsletter updates via email for notifications regarding the 1111 and 1121 rule development and other forthcoming building appliances rules, please subscribe by checking the **Rule 1111, Rule 1121** and **Building Appliances** check boxes located under Rule Updates:

<http://www.aqmd.gov/sign-up>

- To receive printed copies of South Coast AQMD publications via mail, please visit:

<http://www.aqmd.gov/nav/contact/subscription-services>

The screenshot shows the 'Sign Up' form for the South Coast AQMD. At the top, it says 'Sign Up' and provides a brief overview of the newsletter updates. Below this, there are instructions on how to receive daily pollution forecasts (via Air Alerts) and printed copies of publications (via Subscription Services). The form then asks for the following information:

- Email Address: [input field]
- Re-Enter Email Address: [input field]
- First Name (optional): [input field]
- Last Name (optional): [input field]

Below the input fields, there is a section titled 'Rule Updates:' with three options, each with a checkbox and a description:

- Building Appliances: Working Group for Residential and Commercial Building Appliances
- Rule 1111: Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces
- Rule 1121: Control of Nitrogen Oxides from Residential - Type, Natural-Gas-Fired Water Heaters

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