



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

AGENDA: 4

Update on Refinery Corridor Community Air Monitoring

**Stationary Source Committee
November 13, 2024**

**Kate Hoag, Ph.D.
Meteorology and Measurement, Assistant Manager**
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Outline

- Review refinery corridor air monitoring programs
- Refinery fenceline air monitoring
- Refinery community air monitoring
- Upcoming refinery incident particle sampling

Current Refinery Corridor Air Monitoring

Existing programs include fenceline and near-source air monitoring systems

- Facility-operated **fenceline** monitoring systems
- Facility-operated **ground level monitoring stations** (GLMs) at or near the facility boundary
- Air District operated **community air monitoring stations**

Upcoming:

Community-partnered particulate sampling



Other Air and Emissions Monitoring

Other measurements provide context for refinery-oriented air monitoring or detailed snapshots of emissions and air quality

- Regulatory air monitoring stations
- Short-term air monitoring projects
- Air sensor networks
- Continuous emissions monitors, source tests, and other emissions-related measurements



Refinery Fenceline Air Monitoring

- Requirements for refineries to operate real-time fenceline monitoring systems are in Regulation 12, Rule 15 (Rule 12-15), and the associated Air District monitoring guidelines
- Refineries required to obtain and maintain Air Pollution Control Officer (APCO) approval of a plan for establishing and operating a fenceline monitoring system
- Fenceline air monitoring plans for all refineries were conditionally approved in 2018
- Revised fenceline air monitoring plans for hydrogen sulfide (H₂S) were submitted in 2022
- Plans were inadequate and were disapproved, Air District issued Notices of Violation in October 2023

Refinery Community Air Monitoring

- During Rule 12-15 development, Air District committed to expand multi-pollutant air monitoring in refinery communities
- Objectives:
 - Provide refinery frontline communities with real time local-scale air pollution data reflecting day-to-day cumulative air pollution levels
 - Track air pollution levels near refineries over time to assess trends and support long- and short-term air quality assessments
- Established a new community air monitoring fee to recover some of the costs associated with the program
- Air District Benicia site operational as of July 1, 2024

Phases of Air Monitoring Station Development

Siting



- Community input
- Assessment of preferred locations
- Site identification
- Leasing
- Site design & permitting

Construction



- Site construction & station setup
- Equipment procurement
- Equipment installation
- Equipment testing

Monitoring



- Ongoing instrument maintenance and operations
- Data quality assurance
- Data reporting
- Data analysis

Opportunities to Strengthen Existing Programs

- Revise rule and guidelines to expand fenceline monitoring systems to increase confidence in, consistency of, and accessibility to data, based on recent legislative activity and other Air District actions
- Continue to deploy or expand multipollutant air monitoring stations near Petroplus, Blackstone Group, and First Reserve Martinez Refinery Company (PBF MRC), Phillips 66, Tesoro, and Chevron
- Deploy tested real time data instruments for key toxic compounds
- Improve oversight, review, reporting, and analysis of community and fenceline air monitoring data to share contextualized insights with the public

Opportunities to Strengthen Existing Programs (continued)

These improvements are aligned with existing Air District commitments

- *2024-2029 Strategic Plan* Strategies:
 - **2.3** Make Data Accessible
 - **2.7** Understand Local Air Pollution
 - **4.4** Improve Air Monitoring
- Richmond-North Richmond-San Pablo Assembly Bill (AB) 617 Path to Clean Air Community Emission Reduction Plan - Fuel Refining Strategies:
 - **3.13** Improve refinery fenceline and community air monitoring programs
 - **3.15** Refinery-related measurement data accessibility improvements
- Community Advisory Council Environmental Justice Priority to **Collect and Use Data**

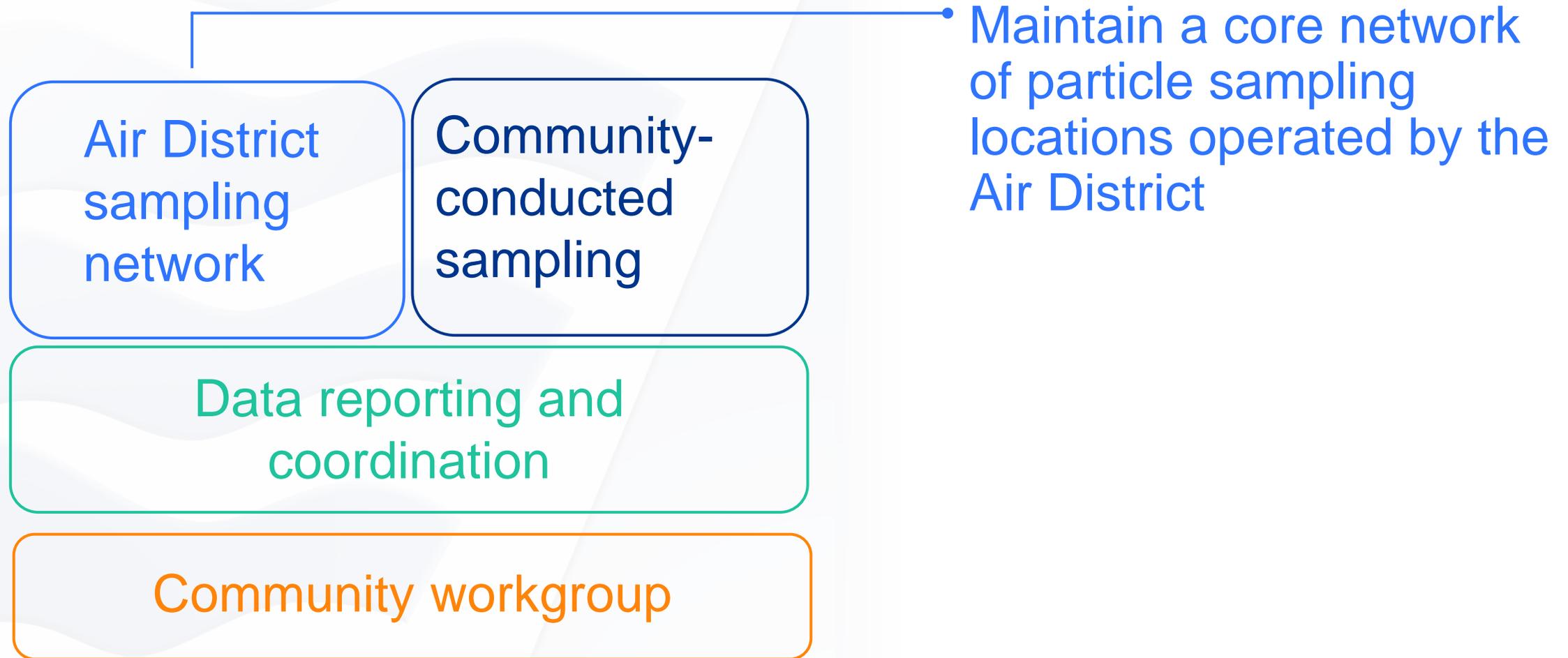
Upcoming: Particulate Sampling for Incidents

- After past events at the refineries, the Air District heard concerns from community members about particulate matter emissions and fallout from the facilities
- Low-cost PM sensors help track plumes from fires at ground-level, but **current monitoring efforts do not capture larger particles** released during certain types of incidents
- Additionally, **community members have expressed an interest in partnering with the Air District to collect actionable information during facility incidents**
- Air District is partnering with community members to implement a new particulate monitoring program to improve air monitoring during unplanned incidents at industrial facilities

Program Purpose

- This program aims to **further characterize impacts of emissions from unplanned incidents** in communities near refineries and **improve the reporting** of the results
- Aligned with Air District commitments:
 - 2024-2029 Strategic Plan Strategies
 - **2.2** Collect Community Data
 - **2.5** Make Data Accessible
 - **2.7** Understand Local Air Pollution
 - **4.8** Air Quality Incidents
 - Path to Clean Air Community Emission Reduction Plan **Fuel Refining Strategies 2.2 and 2.4** about incident response improvements
 - Community Advisory Council Environmental Justice Plan Strategy to **Collect and Use Data**

Program Components



Program Components (continued)

Air District
sampling
network

Community-
conducted
sampling

Data reporting and
coordination

Community workgroup

- Funding and support for community-conducted particle sampling including training on procedures and documentation for sampling

Program Components (continued)

Air District
sampling
network

Community-
conducted
sampling

Data reporting and
coordination

Community workgroup

- Work with community members to present the data with context and make it available in a timely manner

Program Components (continued)

Air District
sampling
network

Community-
conducted
sampling

Data reporting and
coordination

Community workgroup

- Convene a community workgroup to guide the program development and implementation

Community Workgroup

- Guides the program including
 - Identification and selection of preferred sampling locations
 - Recruitment of community members to collect particle samples during incidents
 - Development of methods and procedures for making the data accessible
- Up to fifteen people who live or work near the refineries
- Workgroup members will be compensated \$250 per meeting for preparing for and participating in the meetings

Community-conducted Sampling

- Community members not participating in the workgroup may still be able to help collect samples in neighborhoods near the facilities

Timeline

- September 2024
 - Informational webinar
- November - December 2024
 - Convene workgroup and finalize charter and workplans
- January 2024 – March 2025
 - Workgroup meetings to review monitoring technology and methods, identify monitoring locations, and discuss plans for data dissemination

Timeline (continued)

- April 2025 – May 2025
 - Air District monitoring sites operational (may be phased in depending on ability to secure monitoring locations)
 - Workgroup meetings to review community monitoring plan, siting, and logistics
 - Recruitment and training of community partners
- June 2025
 - Community sampling operational
- Ongoing recruitment and training as needed

General Information and Updates

- The enhanced particulate matter (PM) monitoring project community workgroup will
 - Coordinate with the Refinery Bimonthly Workgroup and the Community Advisory Council
 - Explore other ways to engage the refinery corridor communities more broadly to connect and provide ongoing updates
- A web page with information about the program is coming soon
- Subscribe to our Refinery Stakeholders email distribution list at <https://www.baaqmd.gov/en/contact-us/sign-up-for-information>
- Email: bayaircenter@baaqmd.gov

Questions?



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Indirect Sources - Update

**Stationary Source Committee Meeting
November 13, 2024**

**Virginia Lau
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vlau@baaqmd.gov**

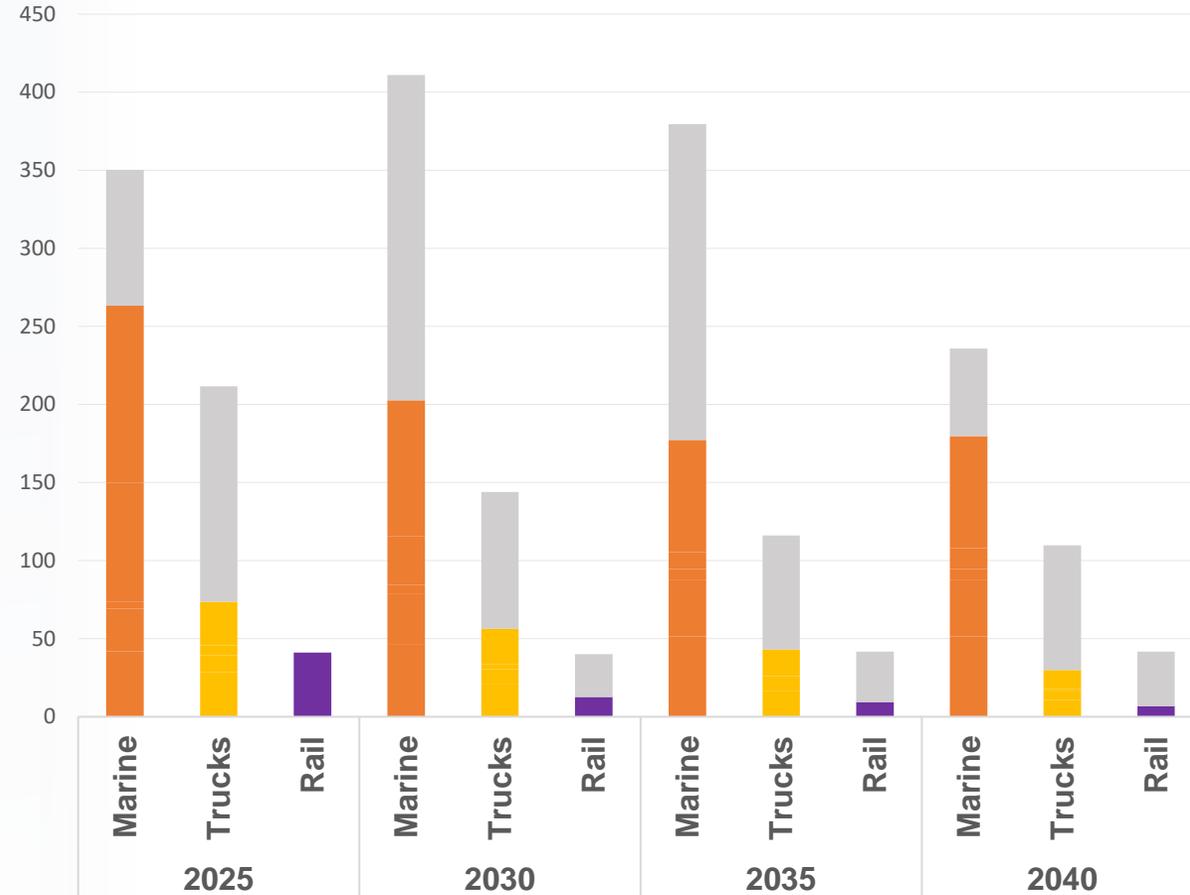
Outline

- Recap of September Stationary Source Meeting
- Responses to questions concerning marine sources
 - Brief overview of California Air Resource Board (CARB) regulations on marine sources
 - Marine source emissions impact on Assembly Bill (AB) 617 communities

Recap of September Stationary Source Meeting

- How many truck-related businesses/warehouses are in the Bay Area?
- What is the projected growth of these businesses?
- What are the marine source impacts to AB 617 communities?
- Are the health impacts different when ships are berthing versus maneuvering?

Bay Area Marine, Medium/Heavy Duty Trucks, and Rail
PM10 Emissions Over Time (Tons per Year)



Gray= without emissions reductions from regulations; Color = emissions with regulations in place)

California Air Resources Board Regulations on Marine Sources

OGV Fuel Regulation

Phased requirement using progressive lower sulfur distillate grade marine fuels starting in 2009

2009

2011

2014

2017

2020

2023

2025

2027

Commercial Harbor Craft Regulation

Multiple requirements starting in 2023 for use of renewable diesel, annual activity data reporting, upgrading engines, idling limits, and use of shore power

Ocean-going Vessel (OGV) At-Berth Regulation

Requires containers, reefers, cruise vessels (for visits to all regulated terminals) to use shore power by 2023

OGV At-Berth applies to roll-on-roll vessels

OGV At-Berth applies to tankers

Key Takeaways

Regional Level

- Marine sources are significant contributors to the regional emissions inventory; nitrogen oxide (Nox) emissions from ships are twice as much of those from all stationary sources in the Bay Area
- Marine sources are major contributor to secondary particulate matter (PM), which has important health impacts

Local Level

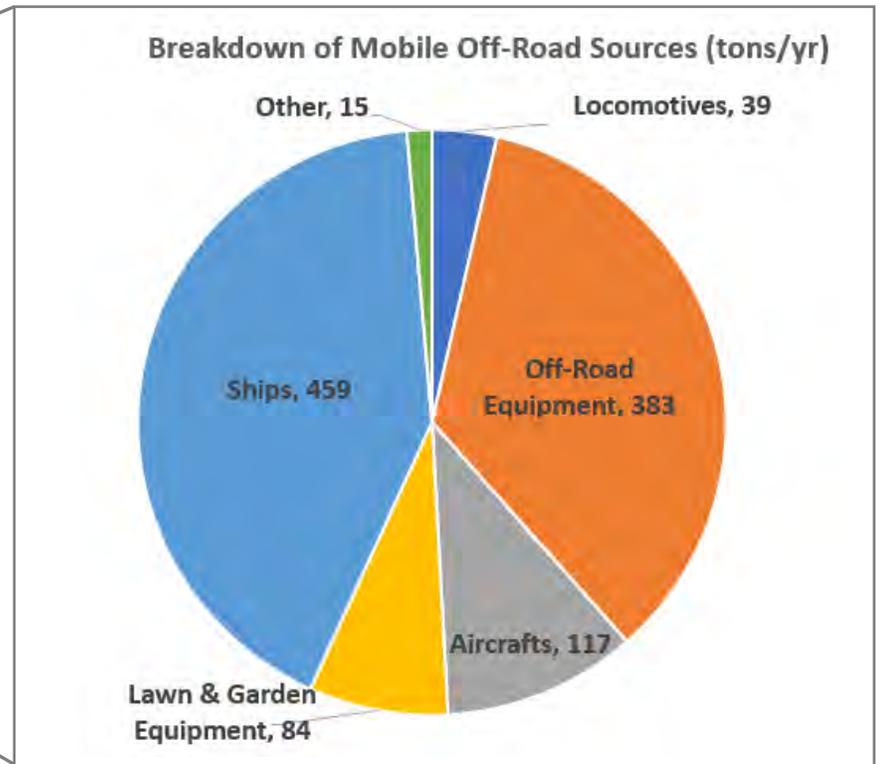
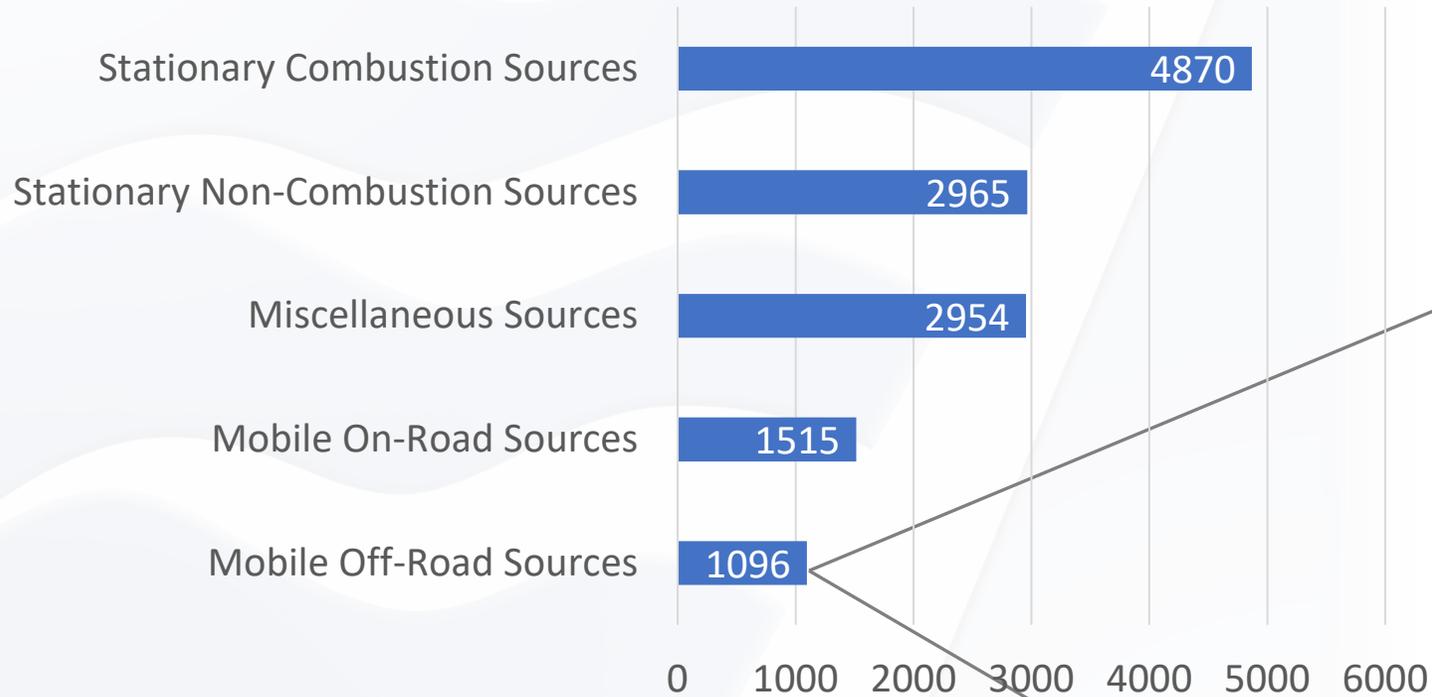
- Exposure analysis for communities indicate that marine sources have lower impacts per ton of emissions than trucks or locomotives (mainly due to proximity differences)

Emissions/Impact Reduction

- CARB At-Berth regulations and new Environmental Protection Agency (EPA) grant will further reduce ship emissions when fully implemented

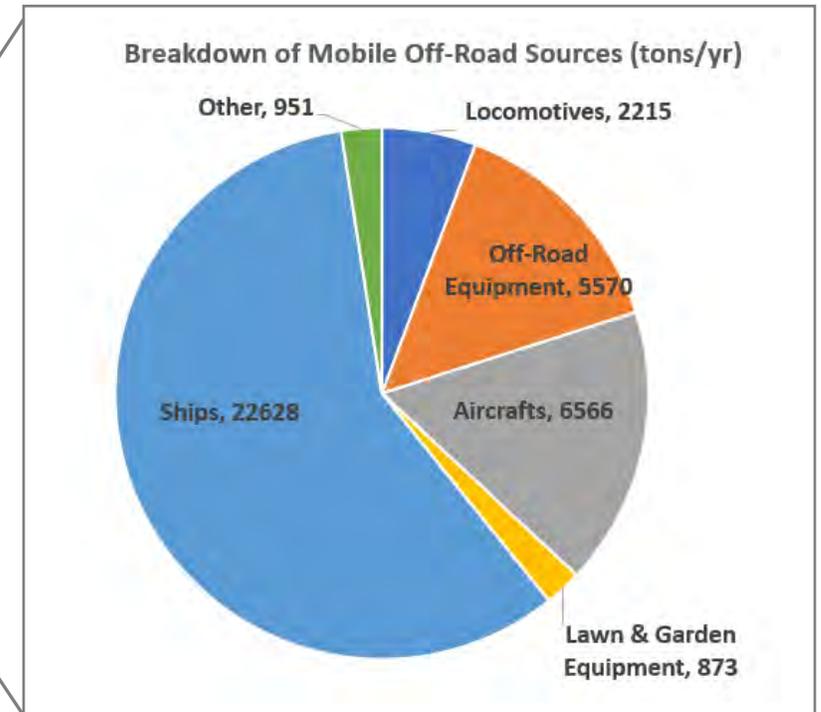
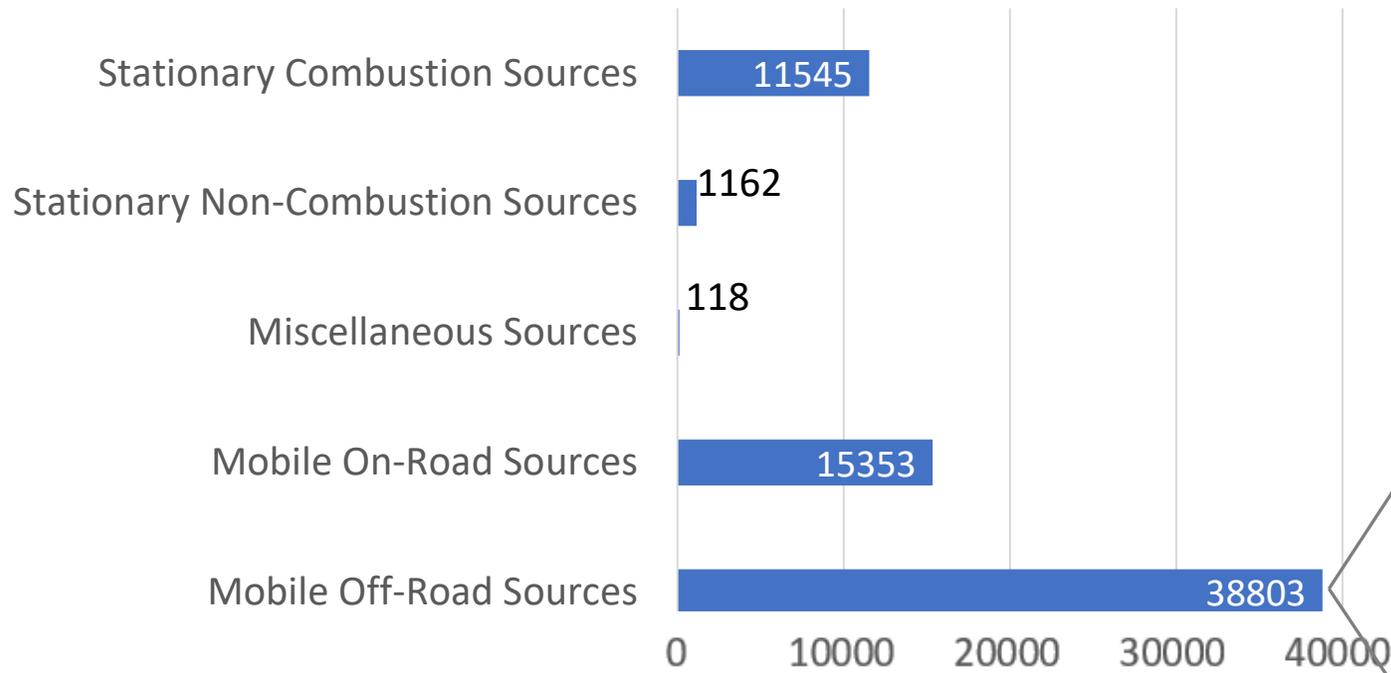
Regional Emissions Inventory for the Bay Area (PM_{2.5})

2023 Regional Inventory by Sector for PM_{2.5} (tons/yr)



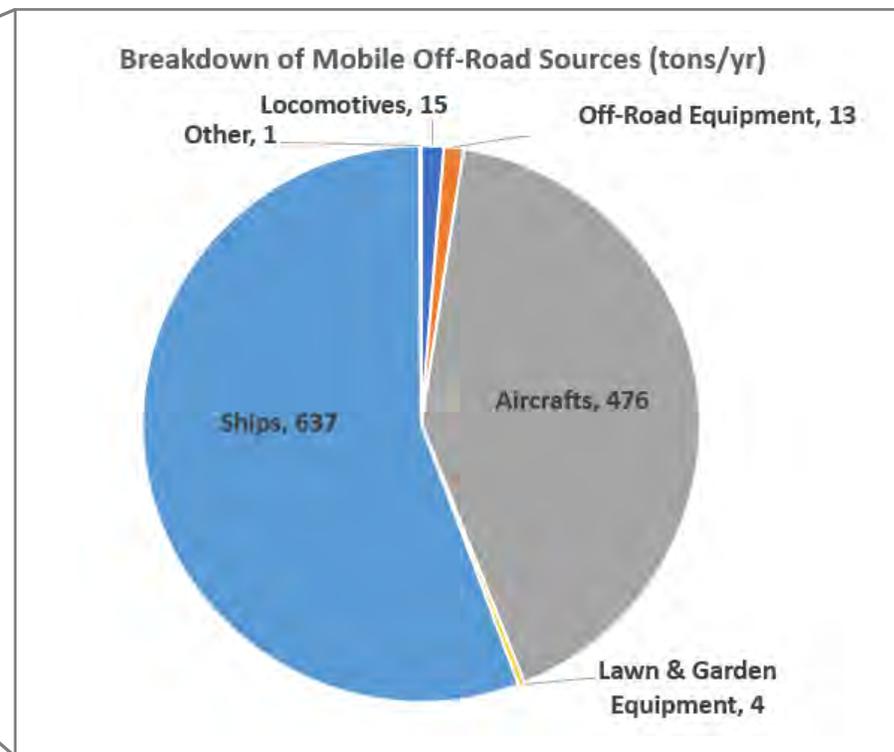
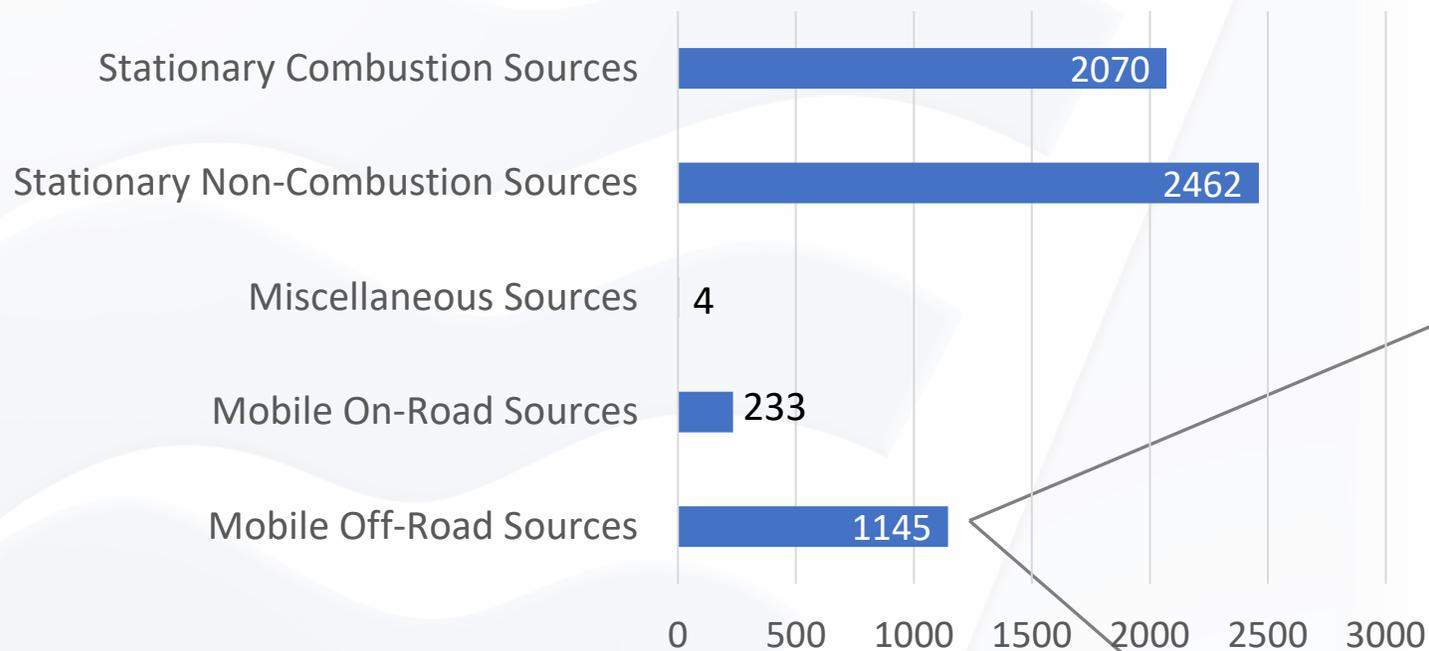
Regional Emissions Inventory for the Bay Area (NOx)

2023 Regional Inventory by Sector for NOx (tons/yr)



Regional Emissions Inventory for the Bay Area [(Sulfur Dioxide (SO₂)]

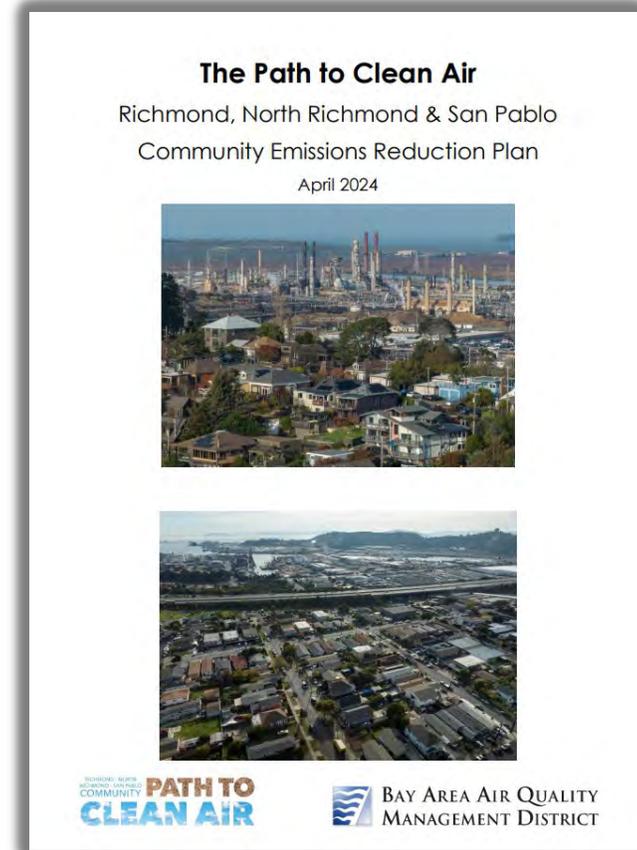
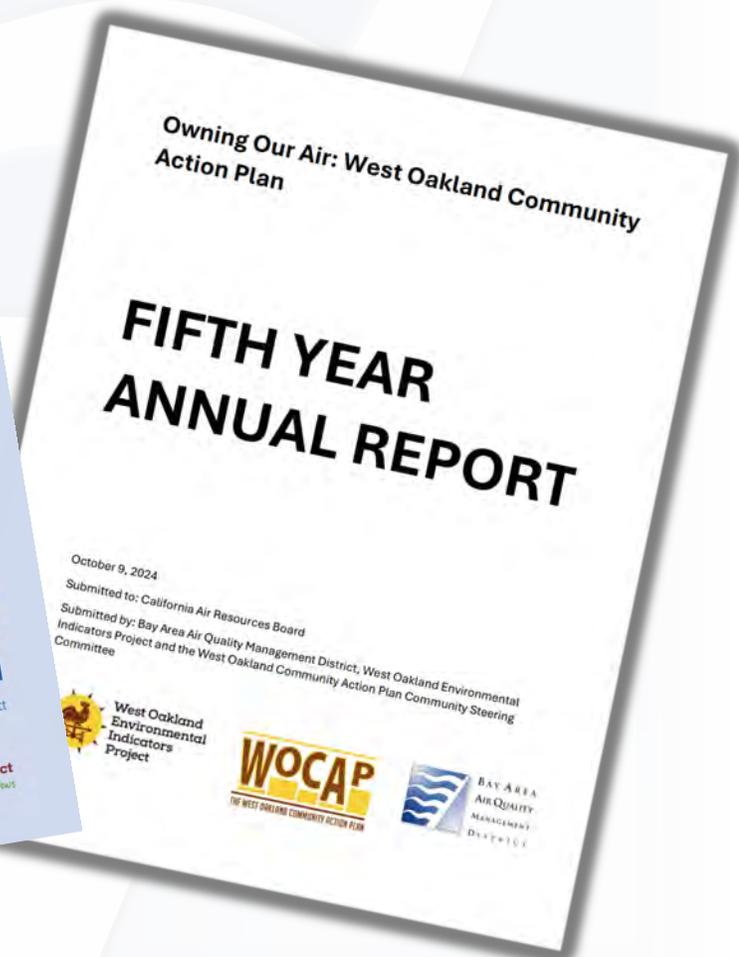
2023 Regional Inventory by Sector for SO₂ (tons/yr)



Assembly Bill (AB) 617 Community Assessments

West Oakland Community Action Plan (2019) and Fifth Year Annual Report (2024)

Richmond, North Richmond, and San Pablo Community Emissions Reduction Plan (2024)



General AB 617 Assessment Methodology



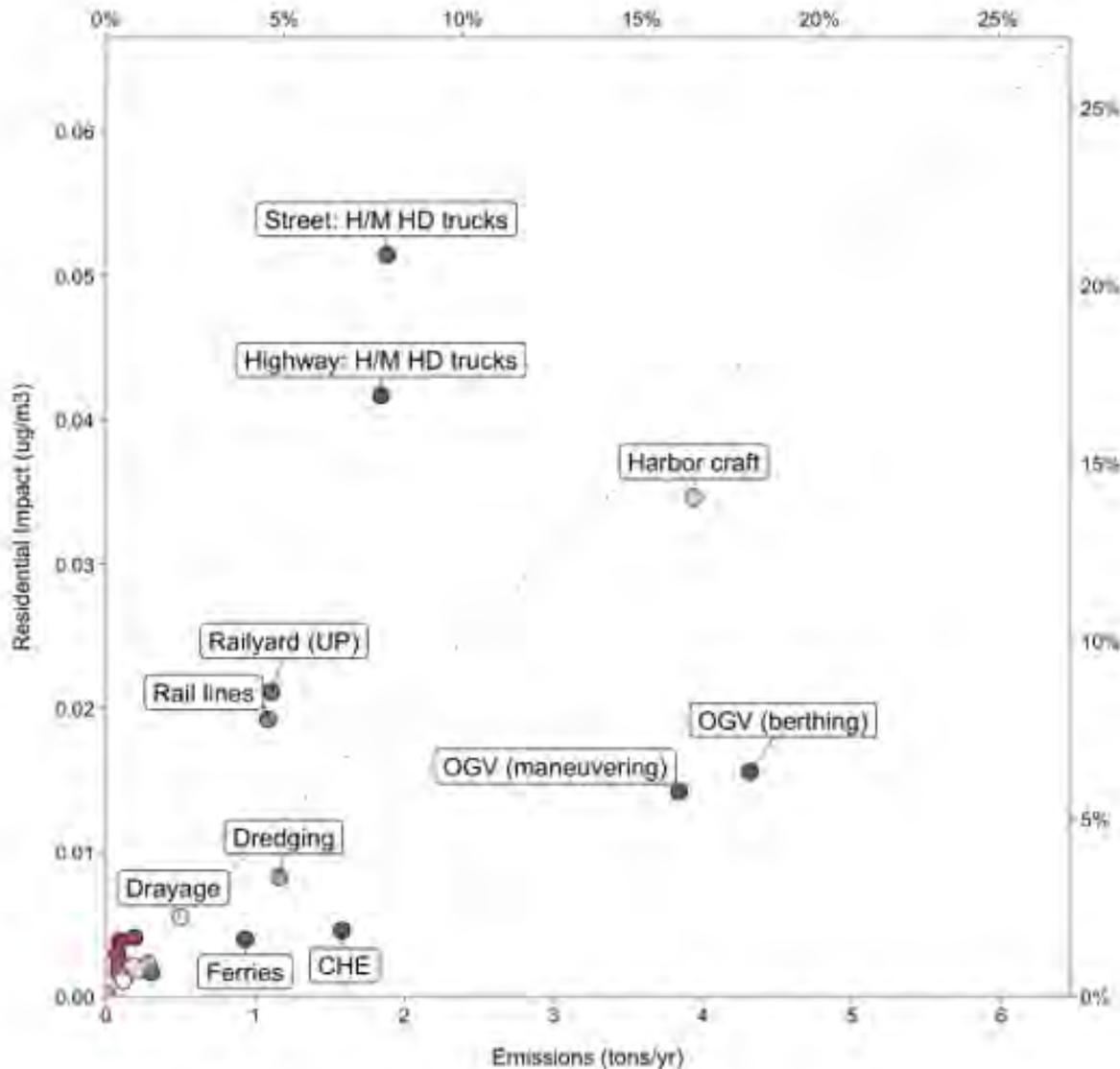
Modeled Annual Average PM_{2.5} Concentrations (ug/m³)

Impact Per Ton: Diesel PM in West Oakland

Circles are modeled local sources.

Red circles create more impact per ton of emissions; blue circles, less.

Percentages are shares of the total modeled impact from these local sources.



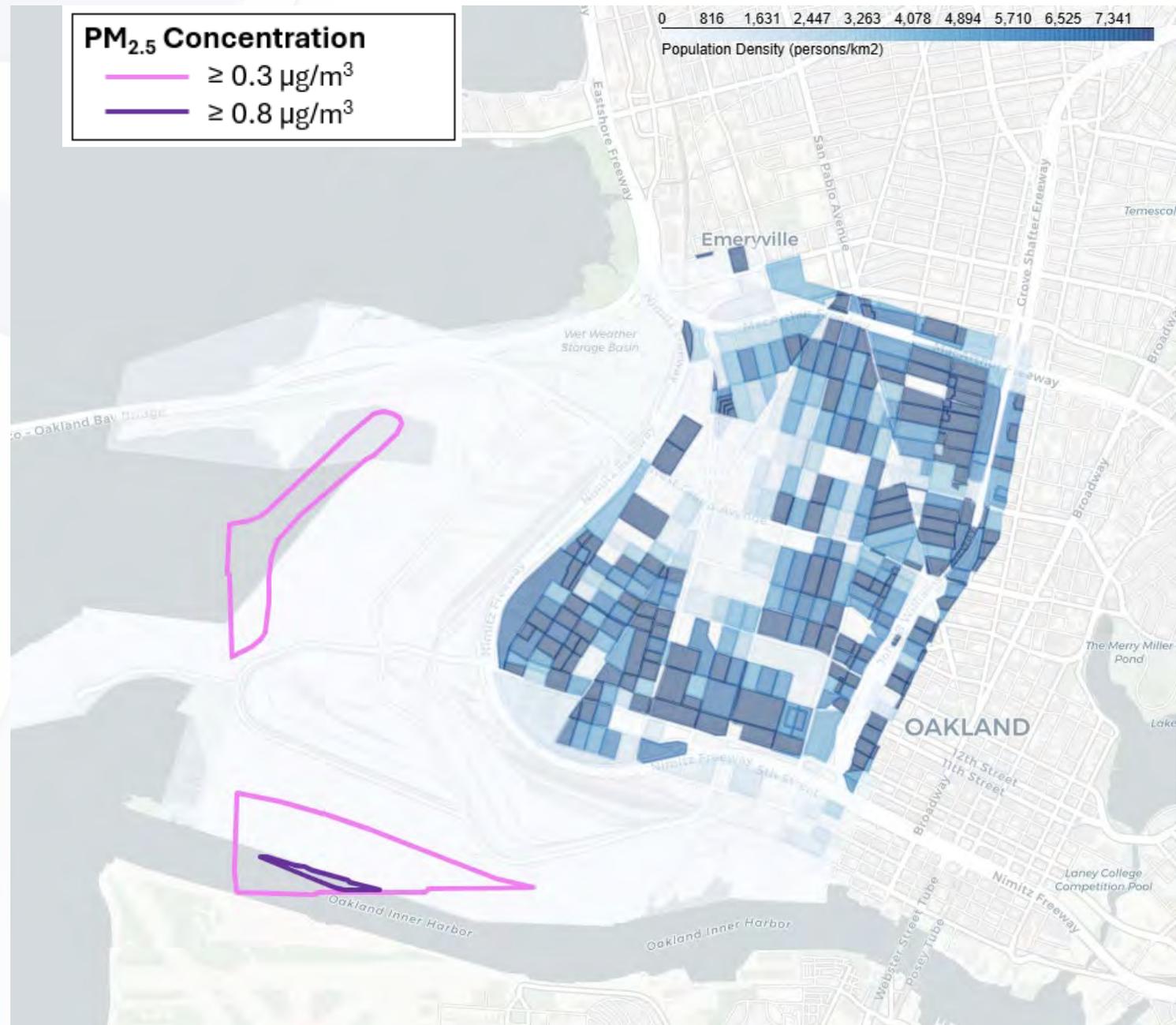
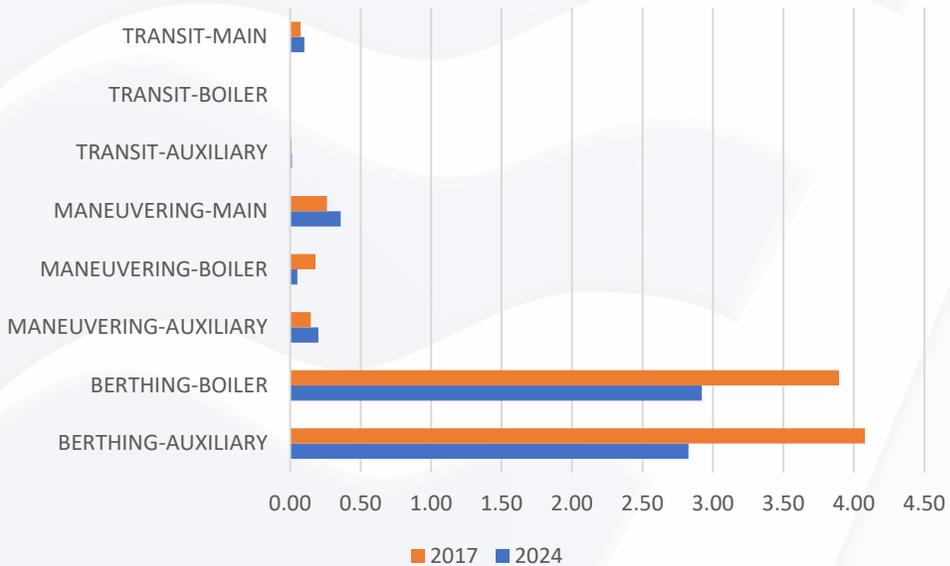
West Oakland Highlights (base year 2017)

- The magnitude of diesel particulate matter (DPM) emissions from trucks, OGV berthing, and OGV maneuvering are similar
- The relative exposure impact of OGV berthing and maneuvering is much lower than trucks, which are 5 x higher than OGV

West Oakland OGV Particulate Matter (PM_{2.5}) Impacts

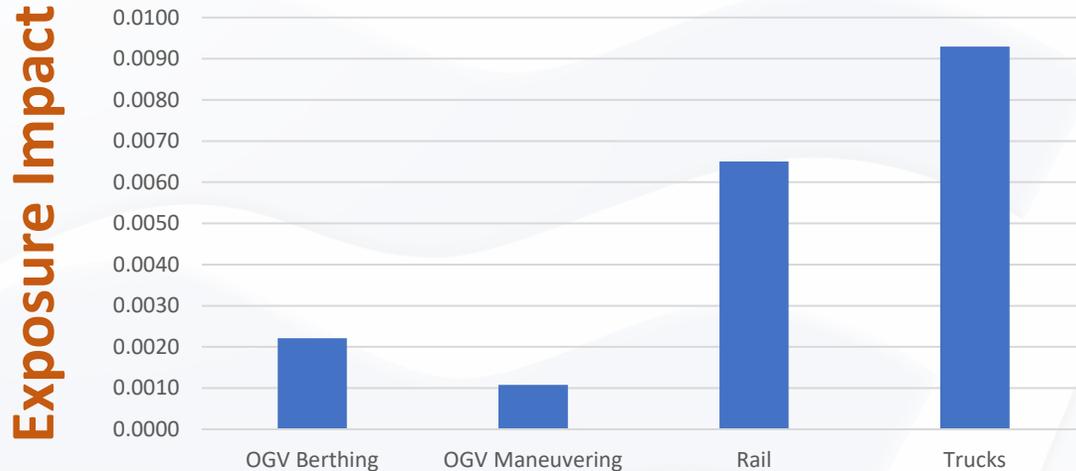
Modeled annual average PM_{2.5} concentrations using 2017 emissions against 2020 block level census track data

West Oakland OGV PM_{2.5} Emissions (tpy) for 2017 and 2024

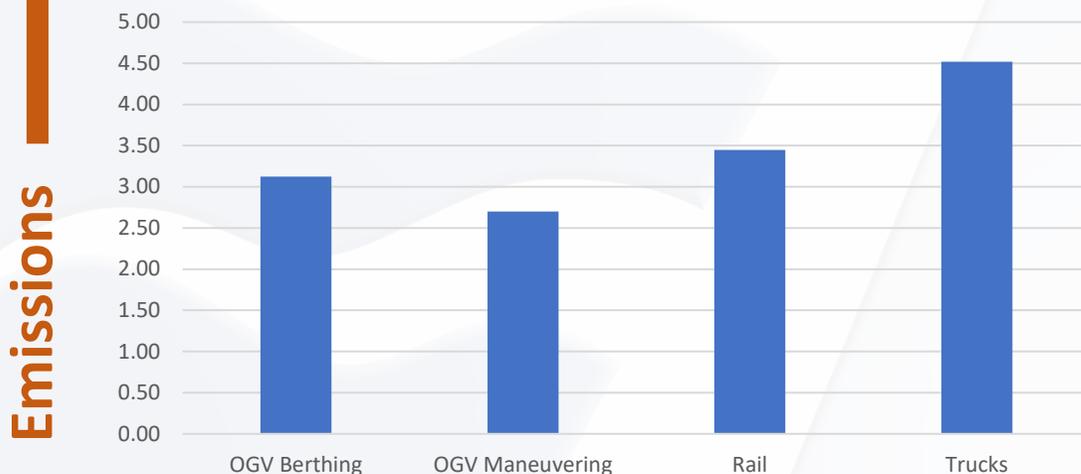


Richmond-North Richmond-San Pablo (Path To Clean Air - PTCA) Recap (base year 2024)

Exposure Impact ($\mu\text{g}/\text{m}^3$) per Ton of DPM Emissions



Diesel Particulate Matter Emissions (tons/yr)

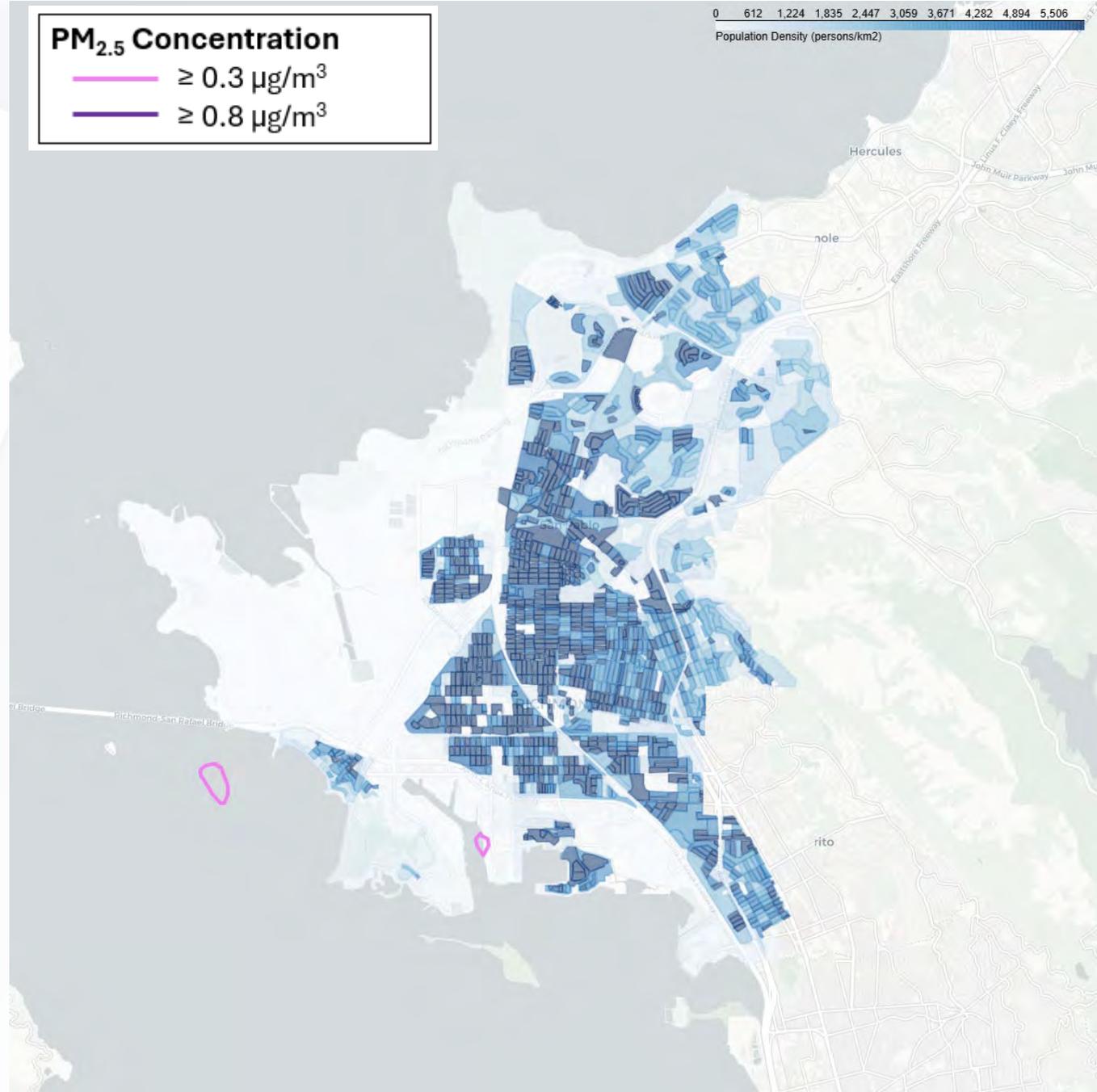
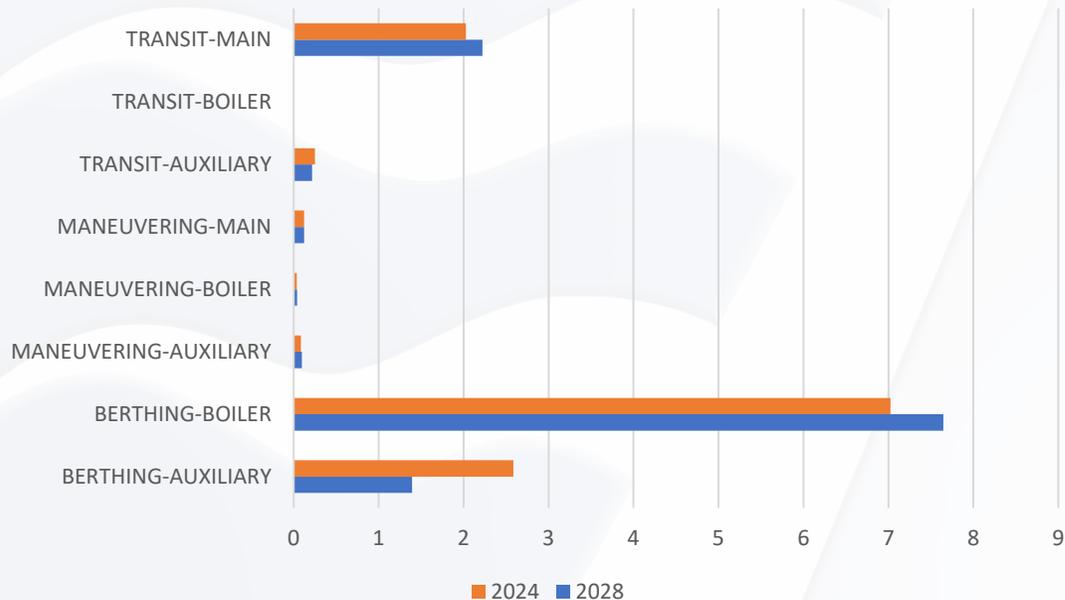


- Most of the $\text{PM}_{2.5}$ emissions are associated with Chevron Refinery in the PTCA community
- OGV berthing exposure impacts per ton of DPM emissions are double of those for OGV maneuvering
- Truck exposure impacts per ton of DPM emissions are 4 times higher than OGV berthing exposure impacts and 8 times higher than OGV maneuvering exposure impacts

PTCA OGV PM_{2.5} Impacts

Modeled annual average PM_{2.5} concentrations using 2024 emissions against 2020 block level census track data

PTCA OGV PM_{2.5} Emissions (tpy) for 2024 and 2028



Recent Headlines for EPA's Clean Port Program

- The awarded \$322 million grant will be used to finance zero-emission trucks and cargo handling equipment (CHE) and improve infrastructure:
 - 475 drayage trucks
 - 180 yard tractors
 - 250+ charging stations/infrastructure
- The Port of Oakland project is scheduled to start in Dec 2024 and complete by Nov 2028.
- The Air District has committed to:
 - Continue participation in the West Oakland Sustainable Port Collaborative and Community Electrification Committee
 - Deploy air monitoring to measure the effectiveness of the project and understand the emissions reductions impacts

Port of Oakland awarded historic \$322 million EPA grant

October 29, 2024

Grant to fund hundreds of zero-emissions trucks and cargo-handling equipment



Source: <https://www.portofoakland.com/port-of-oakland-awarded-historic-322-million-epa-grant/>

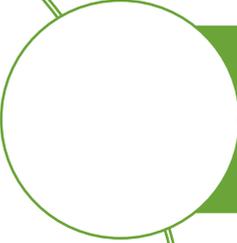
Follow-up Meeting

- Staff to present findings on the number of truck-related businesses/warehouses and their growth projections by early next year
- Staff plan to further assess secondary PM formation and its impact from various sources (including marine sources) as part of our ongoing PM control strategies development

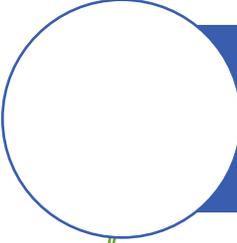
The Future of Building Electrification Programs is Now

November 13, 2024

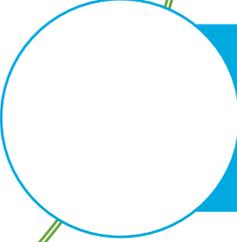
Agenda



Peninsula Clean Energy Overview



PCE Building Electrification Programs



Lessons Learned From The Field

Story From Last Month

1. Customer's water heater broke
2. Went to the PCE website to look at approved loan contractor list for ideas of contractors
3. Had multiple contractors come out the next day
4. Reviewed quotes ranging from \$2.5k to \$13k
5. Within 72hrs, had a 65g Rheem HPWH installed for \$2.5k - rebate and new electrical circuit included
6. Will still be eligible for \$750 in tax credits, making the **net cost to her family \$1,250**



Peninsula Clean Energy Overview



Peninsula Clean Energy Overview

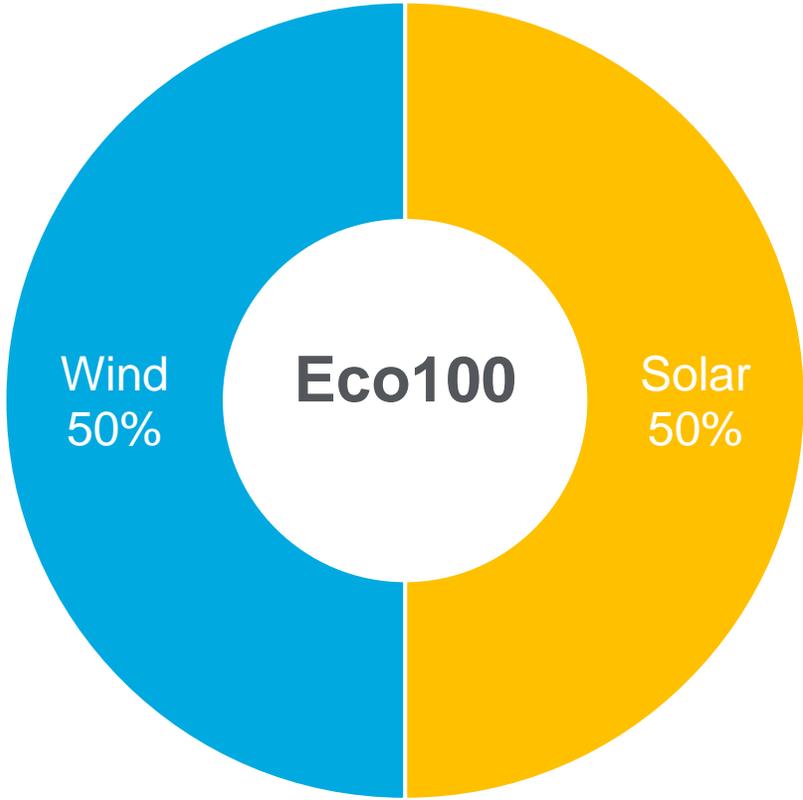
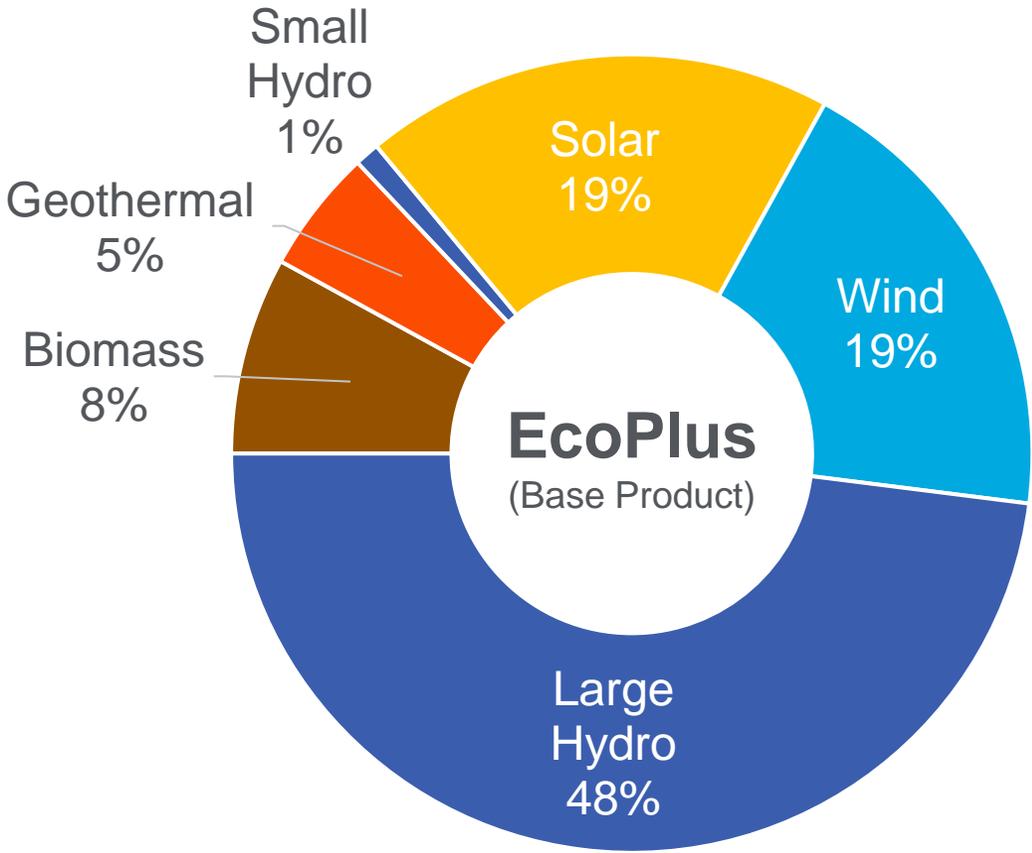


Serving San Mateo County and Los Banos

- Population - 800,000
- \$400m/yr budget
- 3,700 GWh/yr
- 5% lower costs than PG&E
- Clean electricity

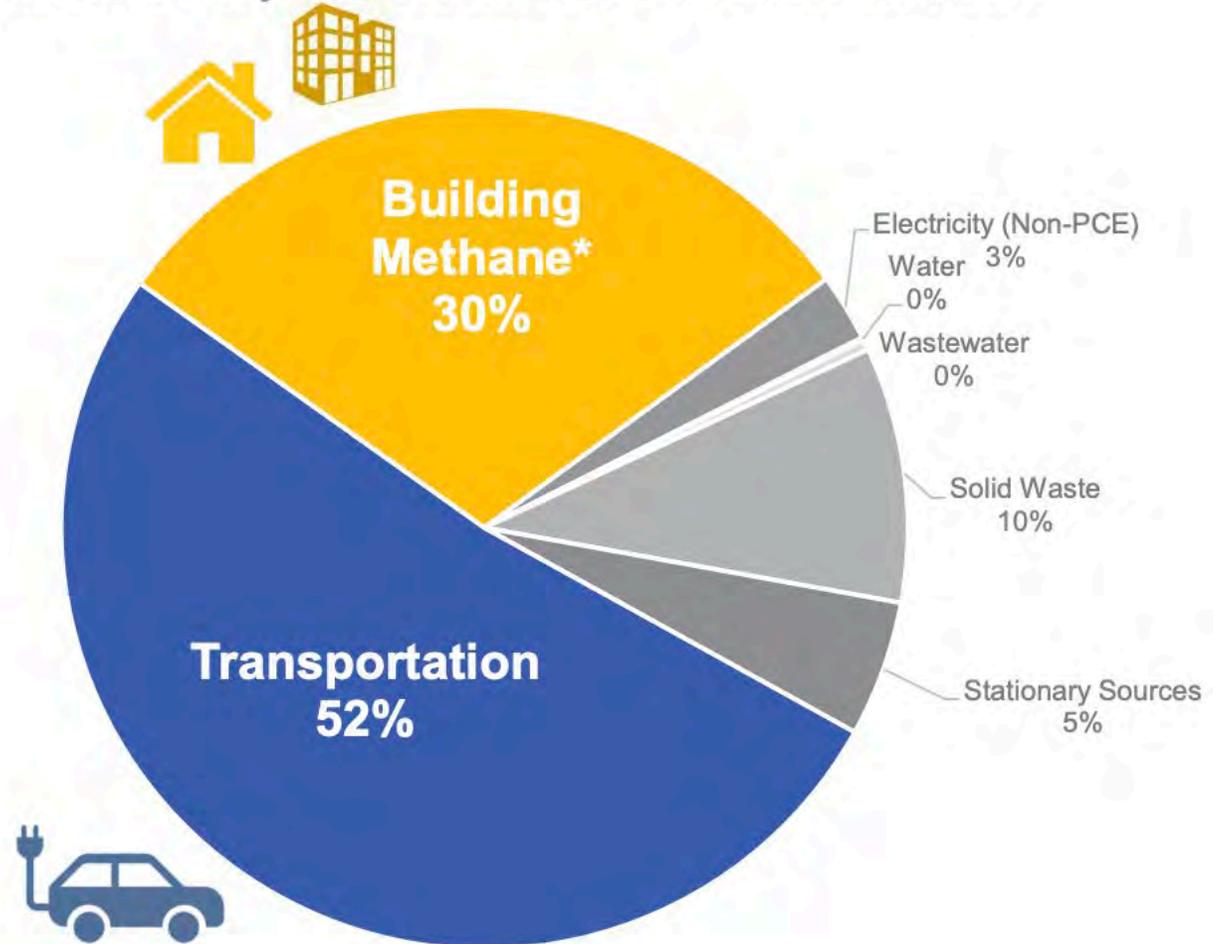


Peninsula Clean Power Mix



Remaining Emissions

San Mateo Countywide Greenhouse Gas Emissions, 2021



PCE Building Electrification Programs

Program Investment

\$31 million

Invested to date
across programs

\$100 million

Planned building
electrification spend
2025-2029

Existing Building Electrification Programs



Rebates for
heat pump water heaters (\$3k)
& heat pump HVAC (\$1.5k)



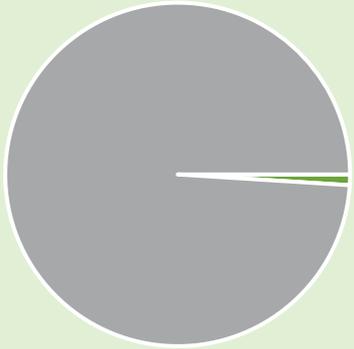
0% loans up to \$10k for heat
pump water heaters & heat pump
HVAC



Home Upgrade program: no-cost
electrification & minor home repairs for
Low Income homeowners

Participants	Count
Rebates	3,513
Loans	663
Low Income Direct Install	305
Appliances installed (all programs)	Count
Heat pump water heater	1,358
Heat pump HVAC	1,896
Induction cooktop/range	75
Electric dryer	73

PCE Building Electrification



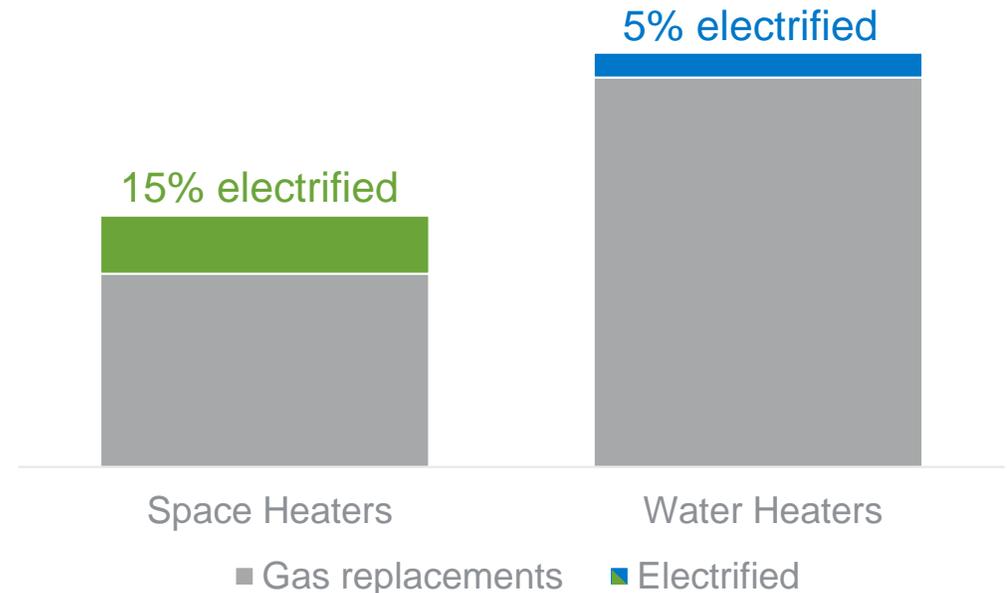
Only 1% of homes in PCE service territory are estimated to take any home electrification step

Annual small residential gas replacements

12,000 water heaters

7,000 space heaters

Electrification rebates as a percentage of replacements in 2023



Home Upgrades Program (New)

\$45 million program in partnership with SVCE
Launching November 2024

Income-Qualified No-Cost Electrification

No-cost whole-home
electrification for low-
income residents

200+ homes per year

Market-Rate Low-Cost Electrification

Low-cost whole-home
electrification for market-
rate residents

Emergency Water Heater Replacements

Rapid replacement of
failing water heaters
with heat pump water
heaters

Residential Programs – Building Electrification



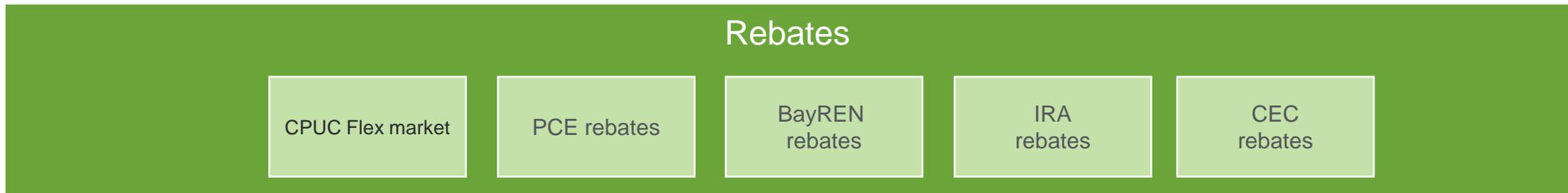
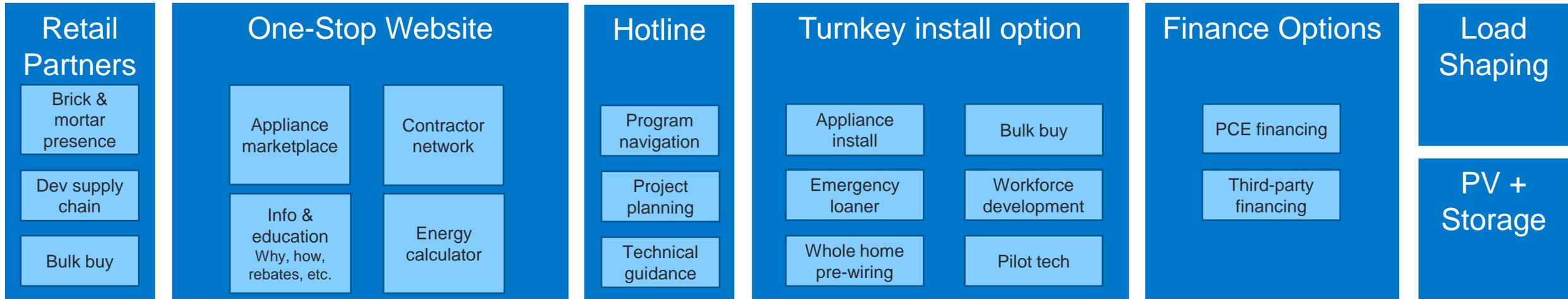
“I want to choose”
(DIY or self-managed)



“Just get it done” &
“It’s an emergency”



“I cannot afford this”
(low income)



Lessons Learned

100A Electrification is Easy
Costs

Do We Really Need to Upgrade Electrical Panels?



Three Reasons Panels are Replaced

Capacity Constrained

Capacity, measured in Amps, is too low to add equipment



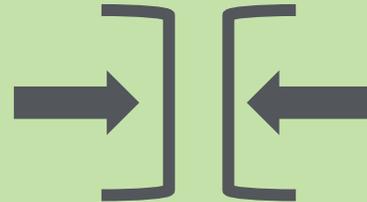
Max. 100A

Solutions to avoid upgrade:

- Circuit splitters
- Circuit pausers
- Smart panel
- Low-amp equipment

Space Constrained

There are no longer spare breaker spaces in the panel



Solutions to avoid upgrade:

- Subpanels
- Circuit splitters
- Smaller breakers
- Breaker re-use

Unsafe to Use

The panel is unsafe to work on, sometimes found on panels from the 1970s or earlier

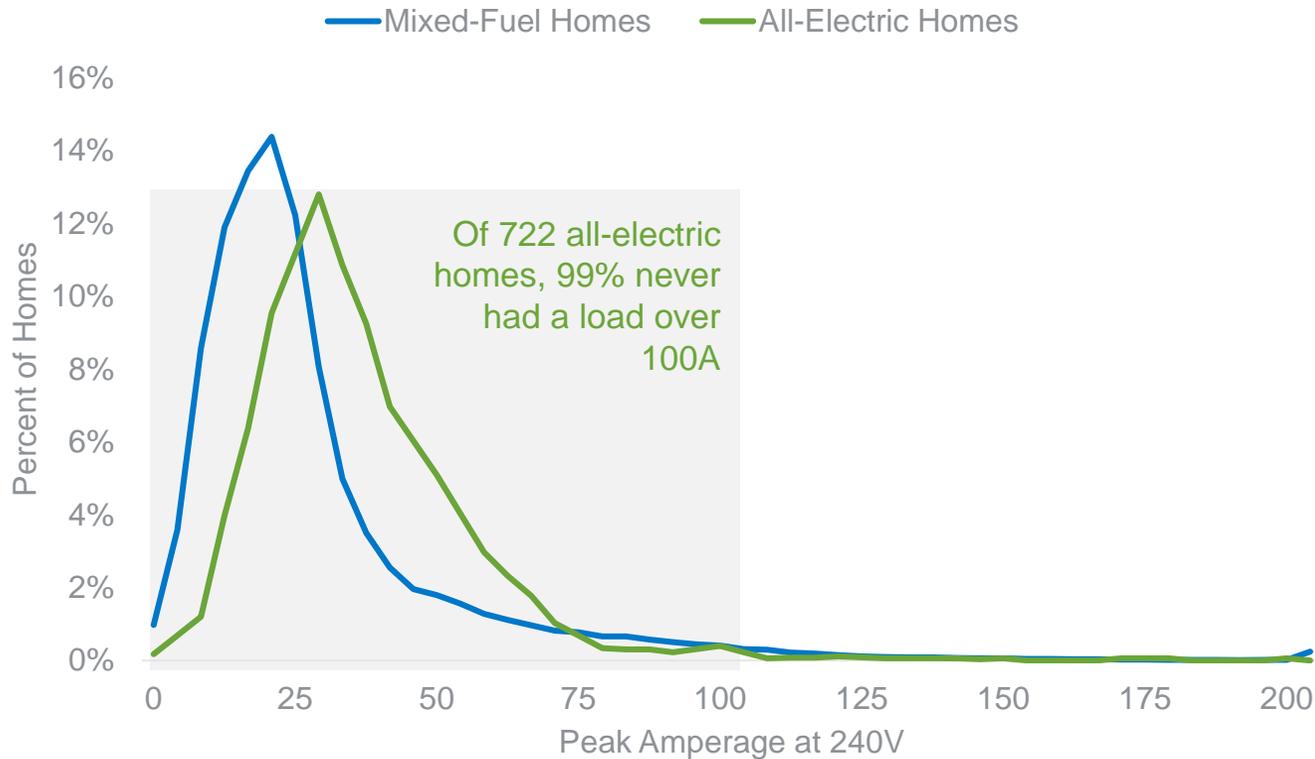


Solutions to avoid update:

The panel must be replaced for your safety. However, it may be worth avoiding a service upgrade using solutions for capacity-constrained panels, and planning ahead by providing breaker space for an all-electric life.

Data shows 100A is enough capacity for most homes

Maximum Annual Peak Demand at Single Family Homes in Peninsula Clean Energy Territory



Peninsula Clean Energy analyzed hourly utility data at hundreds of thousands of customer accounts. The peak demand at customer accounts tended to be well-below the 100A threshold.

99% of all-electric single-family homes use less than 100A of power at all hours of the year.

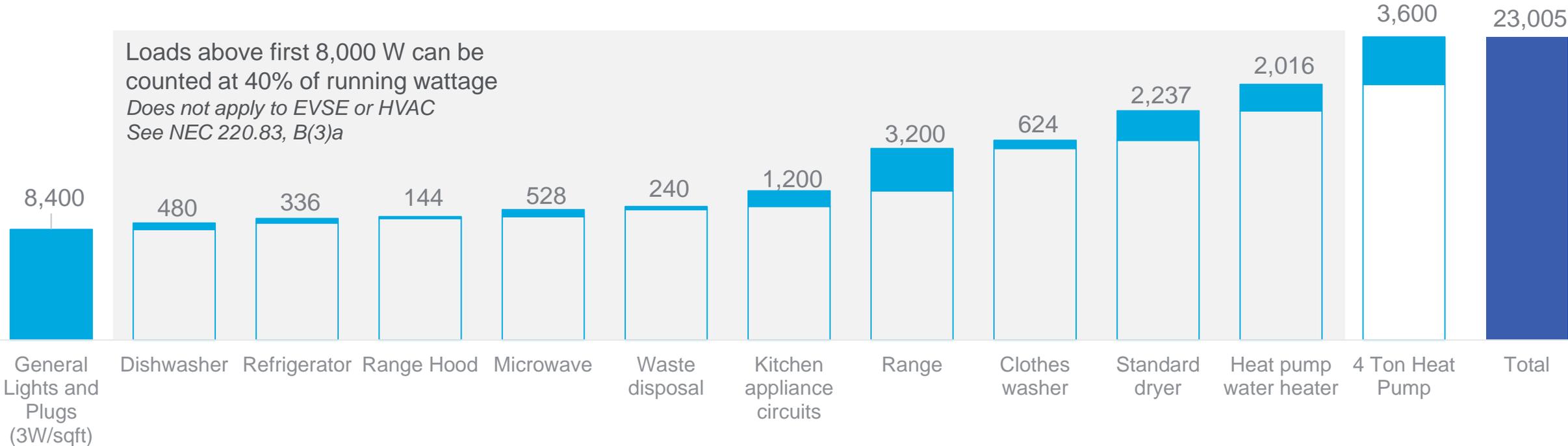
The most common peak demand is 29 Amps, indicating over 70% of capacity goes unused throughout the year.

Over 99% of mixed-fuel, single-family homes use less than 100A of power at all hours of the year.

The most common peak demand is 21 Amps, indicating nearly 80% of capacity goes unused throughout the year. 80% are 38 Amps or less.

Calculation Summary

Panel Size Calculations for Sample 2,800 sqft Single Family Home
(Watts at panel)



Whole Home Pilot

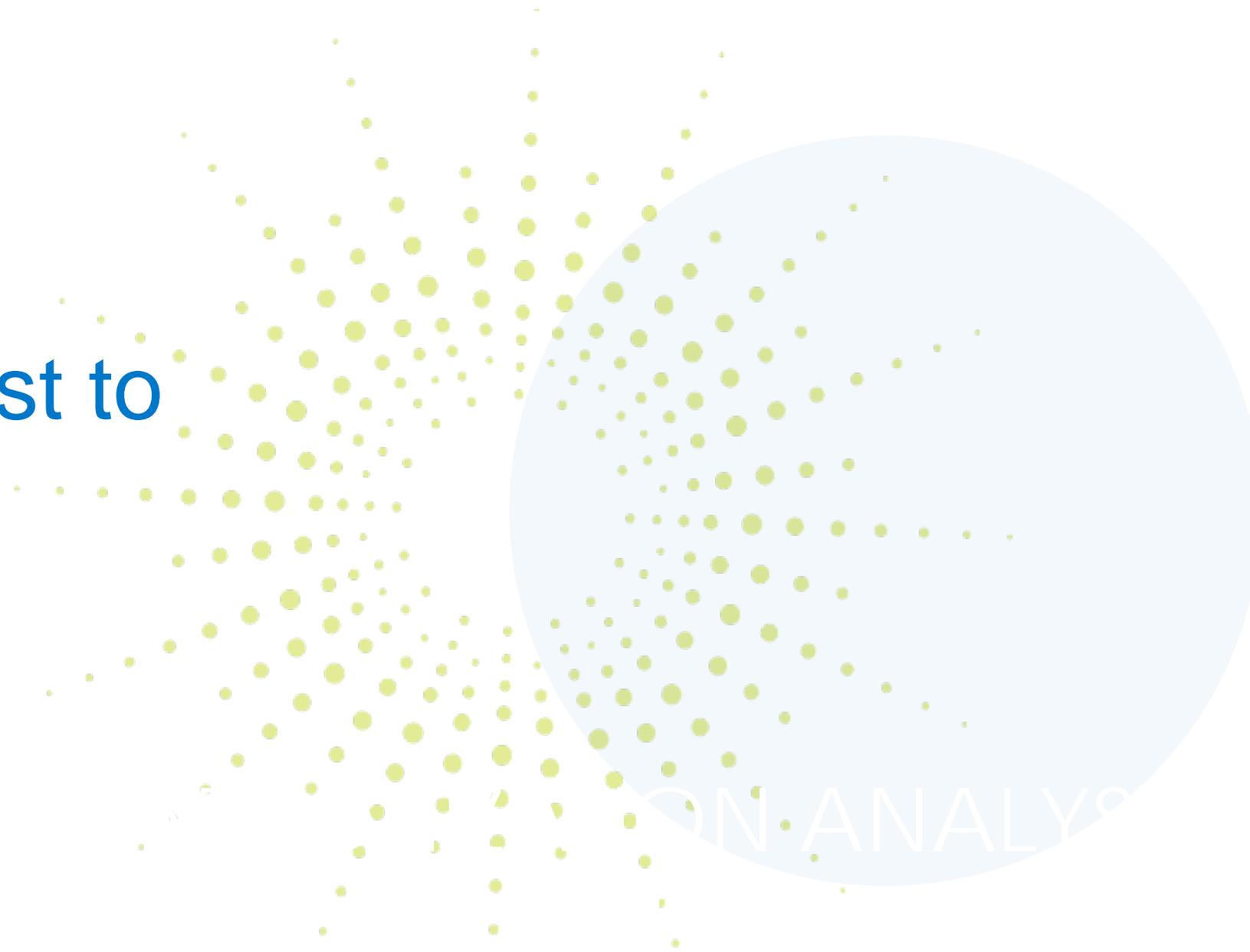


Whole Home Pilot

House	Price	Panel Amps	Service Upgrade
San Mateo 1	\$34,312	100A	No service upgrades required in pilot
Foster City	\$36,179	100A	
Millbrae	\$33,556	100A	
Menlo Park	\$45,187	100A	
Woodside	\$48,595	100A	
San Bruno	\$36,788	125A	
San Carlos	\$12,111	200A	
San Mateo 2	\$35,871	200A	
San Mateo 3	\$31,907	200A	
Average	\$34,945		



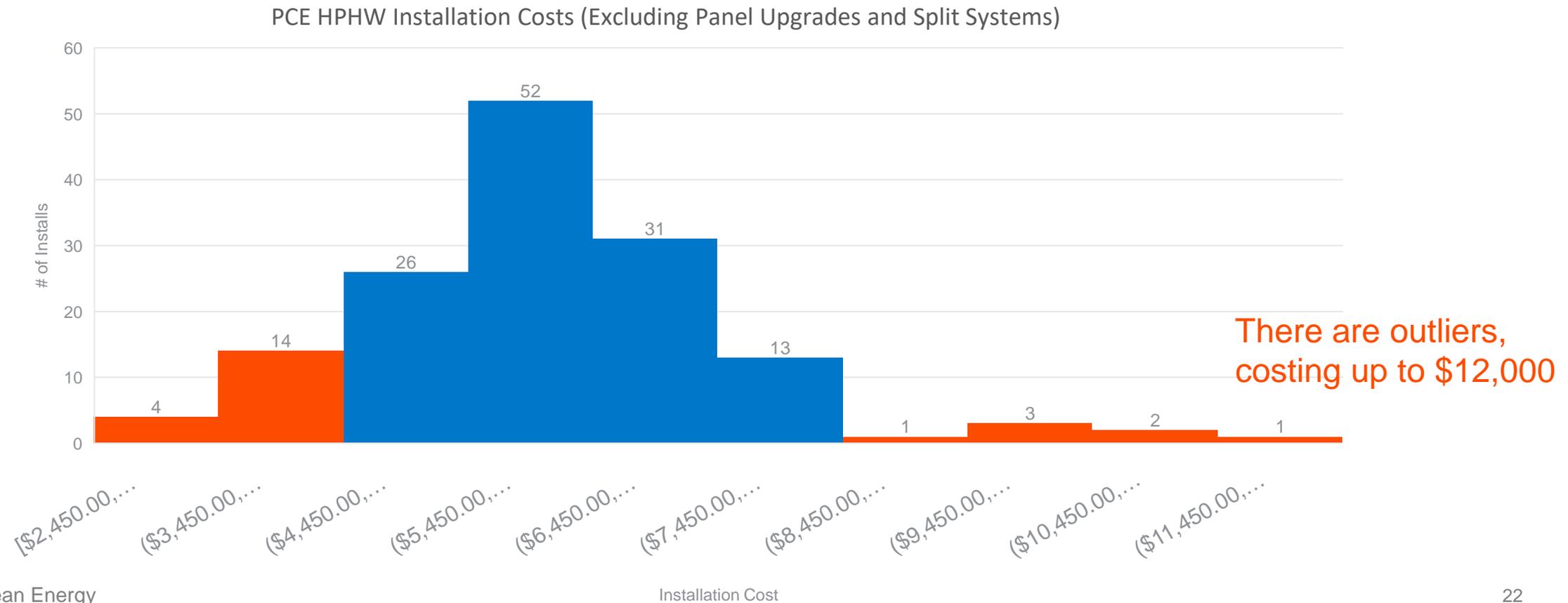
What Is The Cost to Electrify?





Heat Pump Water Heater Costs

Average cost was \$6,100 in 2020
\$6,800 in 2024

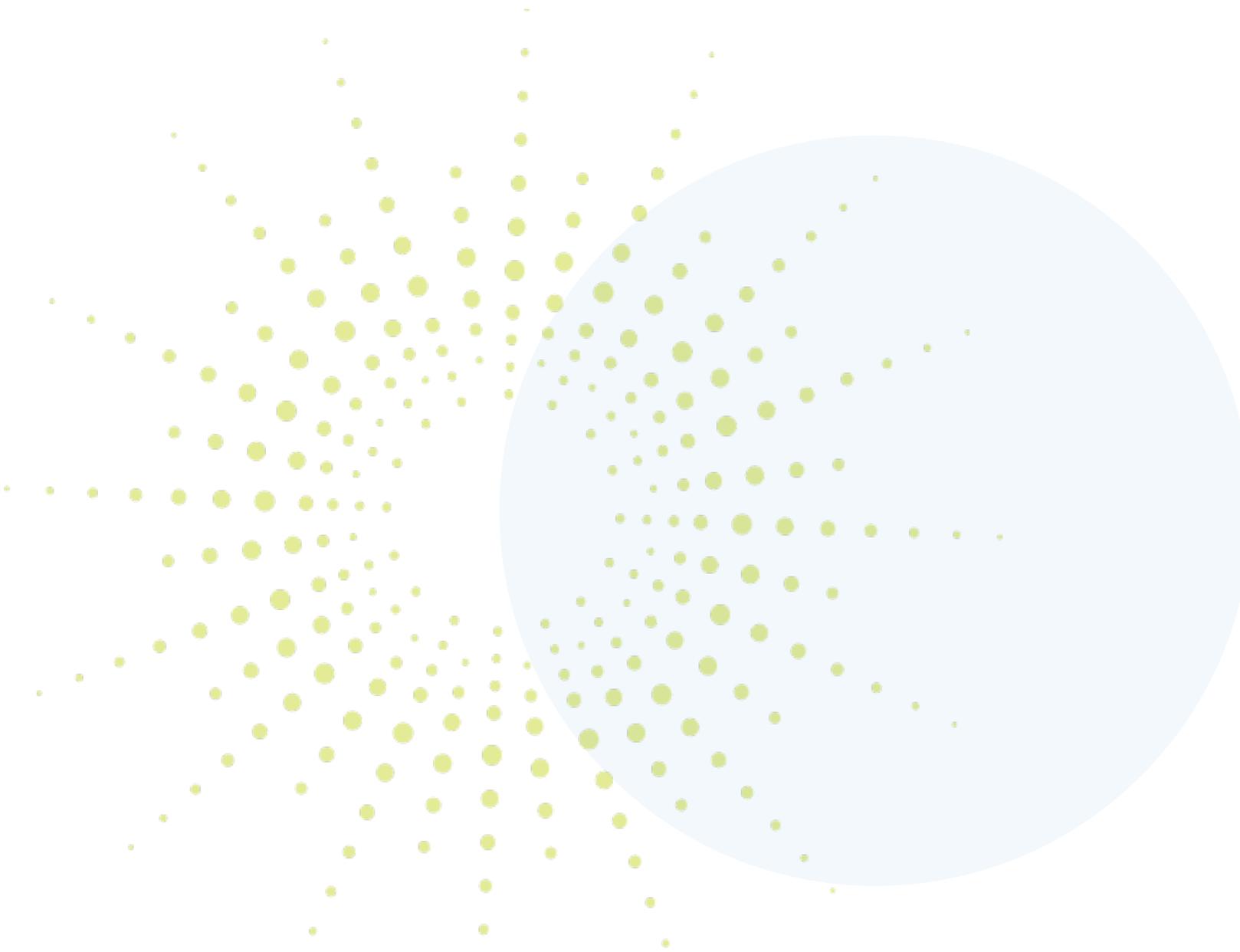




Heat Pump Water Heater Rebate Impacts



Questions?



AGENDA: 6

TECH (+ CaINEXT) Program Insights

November 13, 2024



TECH CLEAN
CALIFORNIA



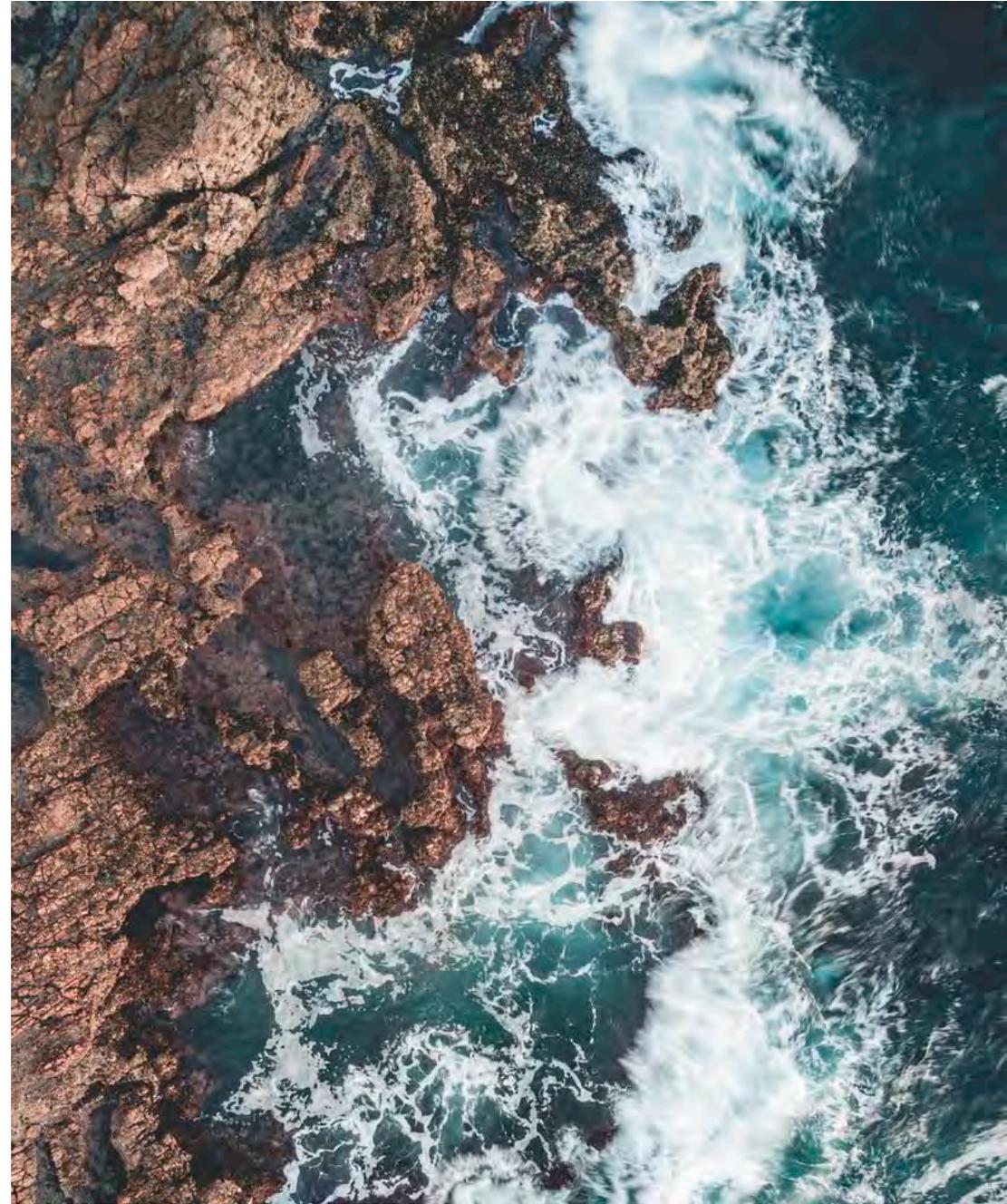
Agenda (15 min)

- 1 Overview – TECH + CalNEXt

- 2 Addressing Challenges - Overview

- 3 Addressing Installation Time & Costs

- 4 What's On the Horizon



1

Overview – TECH (+ CalNEXT)



TECH Clean California Overview

What is TECH Clean California?

- California’s flagship heat pump market transformation initiative for space/water heating
- Guiding principles of scale, equity, regulatory simplicity, and market transformation
- Statewide eligibility
- Launched in 2021 (4-year program) with additional funding since

California Heat Pump Goals



Heat Pump
Water Heating



Heat Pump
HVAC

6 million heat pumps installed by 2030

Climate ready / friendly homes:

- 3 million by 2030
- 7 million by 2035

50% of funding
delivered to low-income households or disadvantaged communities

Source: California Office of Governor website. July 2022.
“Governor Newsom Calls for Bold Actions to Move Faster Towards Climate Goals”

For a more complete overview of TECH Clean California, check out the slides and recordings from our previous quarterly Stakeholder Meetings at techcleanca.com.

TECH Team:



RECURVE



veic



Tre'Laine

The TECH Clean California initiative is funded by California ratepayers and taxpayers under the auspices of the California Public Utilities Commission.

TECH Clean California's Strategic Approach



Spur the clean heating market through statewide strategies

Incentives, supply chain engagement, workforce development, consumer education



Pilots and Quick Start Grants to address market barriers

6 Pilots, 19 Quick Start Grants



Inform long-term building electrification planning

Public data reporting: project cost, carbon, grid, bill impacts and best practices

Deployment To Date:

- > 1,000 contractors participating
- > 35,000 heat pumps deployed
- > 40% of incentives deployed in equity communities
- Over 100 units provided to 30+ training centers throughout CA
- Over 1,500 downloads of TECH Clean California's anonymized project datasets

Market Demand + Workforce Capacity



Technology Maturity + Project Impacts



Incremental Cost + Hassle Factor





- A statewide initiative to identify, test, and grow electric emerging technologies and delivery methods to support California's decarbonized future.
- Ratepayer-funded California Investor-Owned Utility (IOU) program to help with implementation support.
- 170 projects (completed and forthcoming), include but are not limited to:
 - verifying a technology's technical claims,
 - understanding the market barriers, or
 - assessing a technology's ability to provide savings for the IOU portfolios at scale, and evaluating new program approaches.
- CalNEXT.com has information about all current and completed projects.



2

Addressing Challenges - Overview



Market Engagement – Bay Area Results to-date



Spur the clean heating market through statewide strategies and infrastructure

Market engagement	HPWH	HP-HVAC
Contractors engaged	136	230
Brands represented	19	49
Distributor locations ⁽¹⁾	121	90

(1) As of Aug. '23

Create Statewide Infrastructure

- Streamlined incentive clearinghouse
- Standardized data collection and reporting
- Website with consumer and contractor facing resources

Drive consumer demand

- Statewide marketing campaign, strategic customer engagement

Activate the supply chain

- Contractor incentives
- Technical and sales training
- Trade ally engagement

Spectrum of Electrification

Key Variables:

- Electrical Capacity/ Infrastructure
- Physical Space for Equipment
- Products Availability
- Consumer and Contractor Knowledge (• Funding • Rates)

**Simple and
Lower Cost**

**Complex and
Higher Cost**

- ≥ 100 amp panel
- Existing AC
- Physical space in panel
- Space for WH or HVAC equipment
- None to minimal electrical infrastructure issues
- Product readily available and known

- ≥ 100 amp panel
- No AC
- Limited physical space in panel
- Some additional electrical work required

- ≤ 100 amp panel
- No AC
- Panel in non-compliant location
- Underground utilities
- Electrical capacity constraints (apt)
- Physical space constraints for equipment

Addressing Challenges - Highlights

- **Replacement Timing:**

- Temporary Equipment – pilot and integration into programs

- **Installation Costs:**

- Avoiding Panel Upsizing – pilots and tools
- Comprehensive Support – pilot
- Multifamily – pilots and tools
- Expanding workforce – pilots and trainings*
- Financing – pilots and research*

Operational Costs: Forthcoming in ~Q1 '25

- Analysis of the real-world bill implications
 - Meter and bill impacts, including peak demand and load shifting impacts
 - Including analysis of Fixed Charges and electrification rates

*slides in appendix

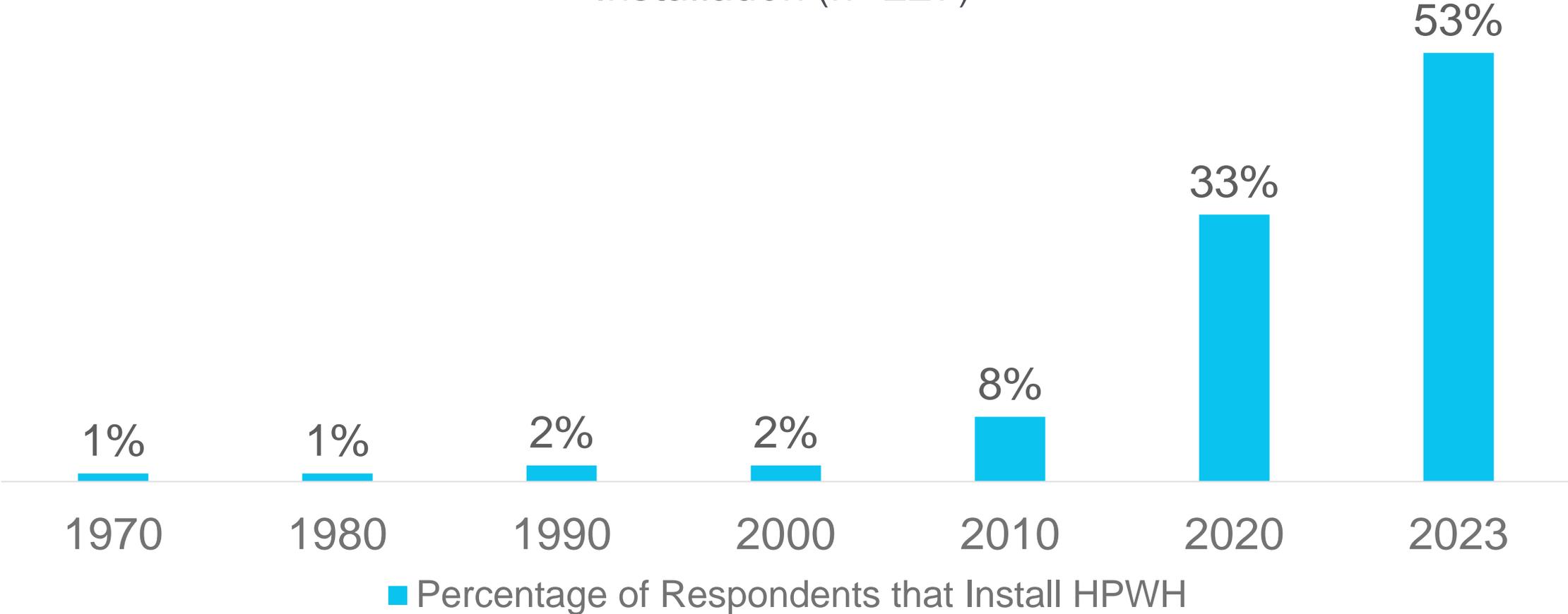
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Addressing Installation Time + Costs



Heat Pump Water Heater Adoption is a Relatively Recent and Growing Phenomenon in California, Contractor Survey

Percentage of Respondents that Install HPWH by Decade of First HPWH Installation (n=127)



Temporary Equipment

Barnett Plumbing & Water Heaters Gas Loaner Program

QUICK START GRANTS

Installed

- 149 heat pump water heaters
- 127 gas loaners

PROBLEM STATEMENT:

HPWH retrofits often take too long when emergency replacements are required.

GOAL:

Test feasibility of loaning customer temporary gas water heater until HPWH retrofit can be completed.

SCOPE:

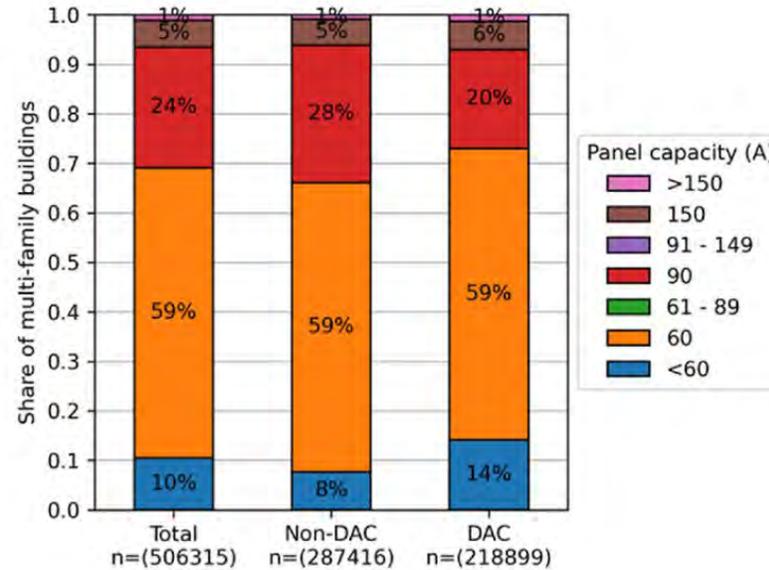
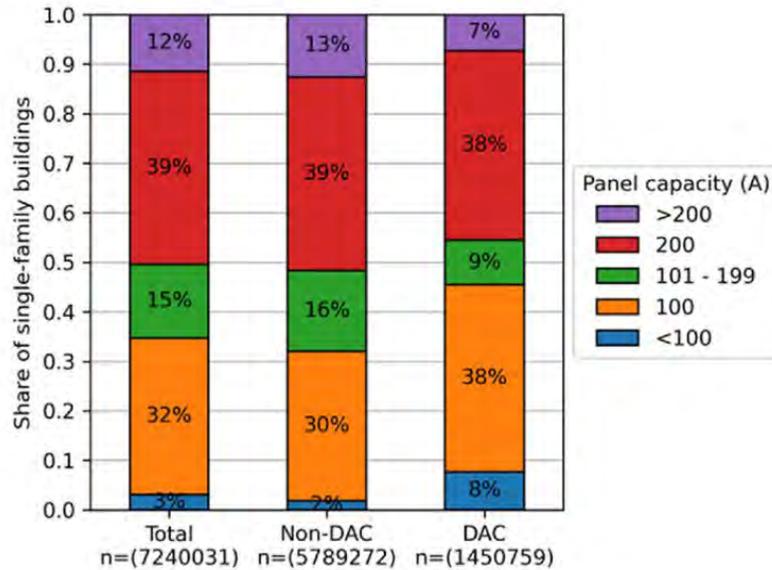
- TECH provided \$975 per project to cover loaner costs.
- New 120V plug-in HPWHs added as an alternative to gas loaners.

RESULTS:

- Barnett's electrification at time of emergency replacement increased from 1% to 17%.
- City of Palo Alto Utilities, SVCE, MCE, & PCE now incorporating into their programs.
- Some contractors incorporating into business model, as option for customers.

Avoiding Panel Upsizing

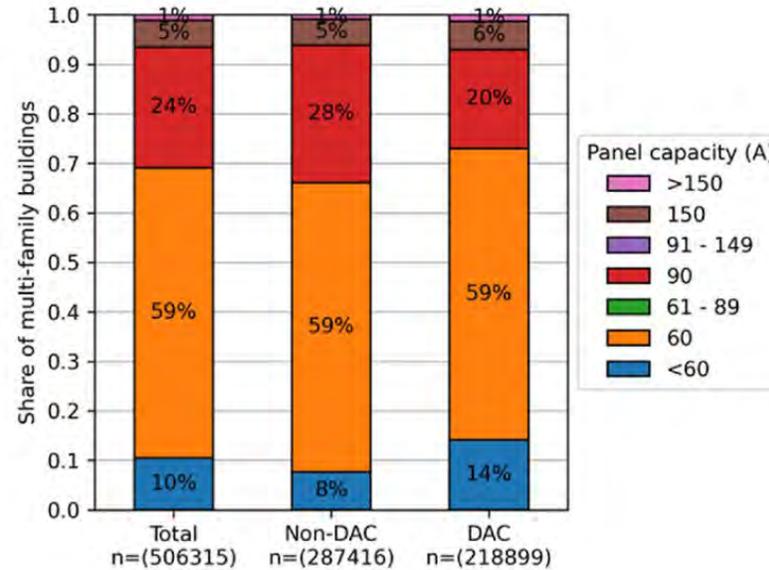
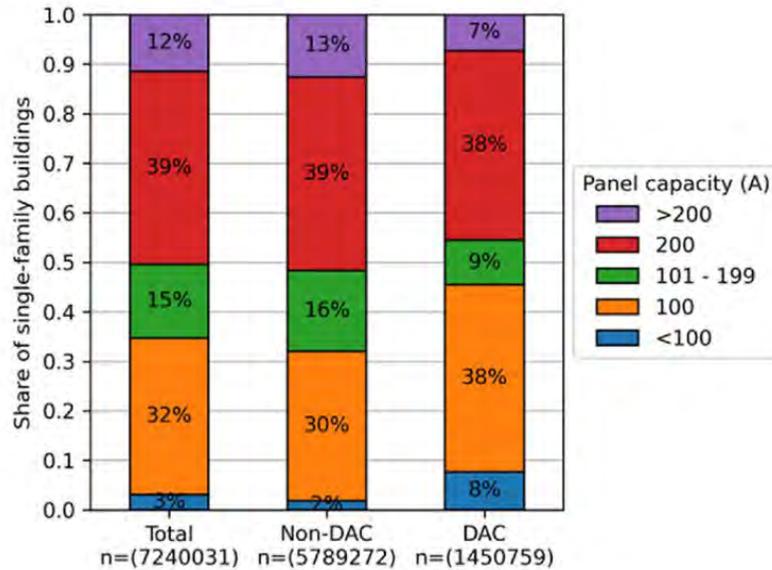
- Per TECH analysis, electrical work, including upsizing adds ~\$1,200 to ~1,500 to project costs, on average.
- Fournier et al., (2024) analysis using TECH data estimates:
 - ~3% of **Single Family (SF)** and ~10% of **Multifamily (MF)** in CA should require panel upsizing
 - ~32% SF of ~59% of MF can electrify without upsizing by applying Watt Diet strategies



Fournier et al. (2024) "Quantifying the electric service panel capacities of California's residential buildings"

Avoiding Panel Upsizing

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Result: Plans for easy-to-use decision tool for electrical panel optimization to avoid unnecessary panel upsizing.

Project now being funded by Energy Commission for development and demonstration.

Fournier et al. (2024) "Quantifying the electric service panel capacities of California's residential buildings"

Comprehensive Barrier Removal



► HPWH Conversion Readiness
Program Focused Pilot

Active 2024/12

PROBLEM STATEMENTS:

1. Higher first costs due to additional expenses for electrical upgrades
2. Customer uncertainties around electrification impacts
3. Lack of trained installers.

GOAL:

Test customer adoption impact of removing three barriers.

SCOPE:

- Offer customers a free “heat pump readiness assessment” with forecast utility bill impacts, available incentives, proposed work scope.
- Free electrical upgrades to prepare them for electrification.
- Train installers to create a scalable model for delivery state-wide.

California Multifamily Landscape

- ~Half of low-income households in California live in multifamily properties and majority are rentals
- Common system configuration:
 - Majority have in-unit HVAC
 - About 50/50 split between in-unit and central domestic hot water
- Heat pump retrofits not yet business as usual, but have strong policy and program support



Common retrofit scenarios



- **Stand-alone** energy retrofits largely driven by programs
- **Comprehensive** incorporated in larger rehabilitations at **capital events** (refinancing, tax credit investment)
- **Over time** at failure or unit turn
 - Common practice is like-for-like
 - Harder with dissimilar systems, new form factors

Multifamily Issues and Strategies

Funding and Timeline Impacts

- **Electrification readiness** – allows for planning and investment today
- Phased approaches in retrofits

Increased Electrical Loads – time and costs

- Leverage energy efficiency to reduce loads
- **Sharpen pencil on load calculations**
- Select low Amp equipment Elec load

Uncertainty in New Systems

- **Central HPWH design; sizing; performance and monitoring**
- Share out data and methodology and provide training

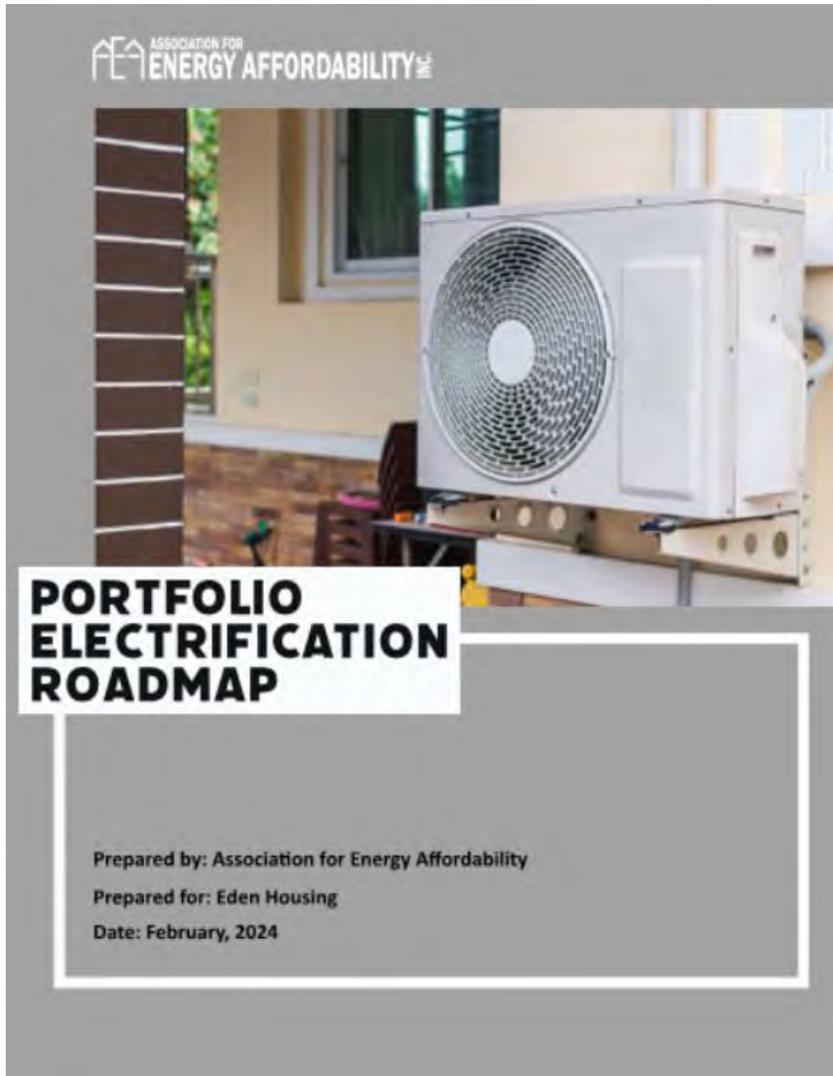
Utility Costs

- Comprehensive – Cost effective, EE, PV
- Ensure residents can realize additional benefits for health and comfort

Prioritization of Capital Events for Funding

- Planned modernization can support electrification

Multifamily: How TECH Pilots Are Uncovering Opportunities and Advancing Market



- **Electrification Readiness to Enable Future Electrification**
 - Serving 393 units - 10 projects
- **Closing the Funding Gaps for All-Electric Retrofits**
 - Serving 178 units – 7 projects
- **Holistic Planning to Electrify Owner's Portfolio**
 - Serving over 27,000 units
- **Building Capacity to Support Central HPWH Retrofits**
 - Serving 661 units

Multifamily

Data collection to inform future planning and design



► Multifamily Central Heat Pump
Water Heater Field Study

Active

2026/02

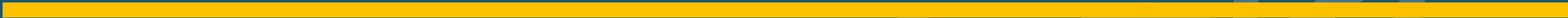
PROBLEM STATEMENT: Lack of data on costs and system performance for Central HPWHs in multifamily buildings

GOAL: Identify design, installation and operational features that are critical for a success application.

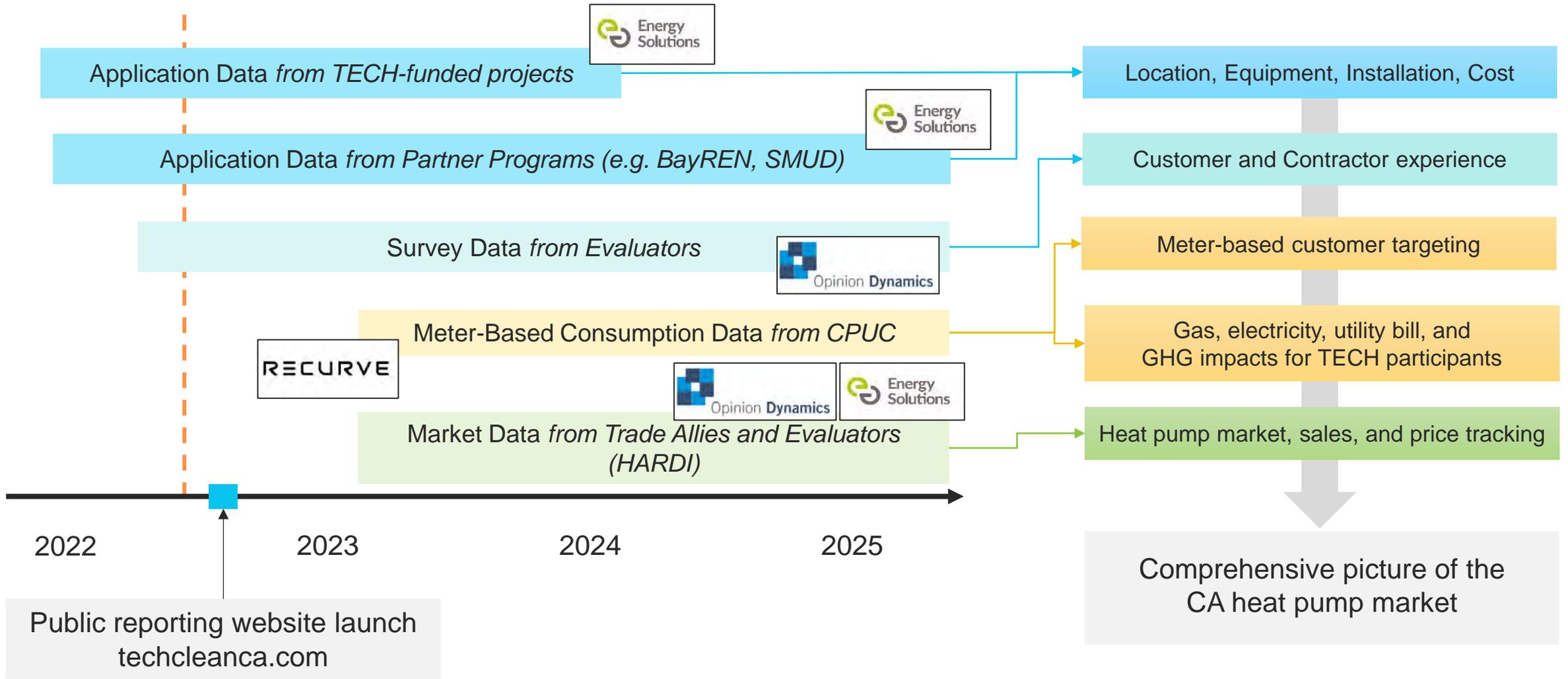
SCOPE: Field performance evaluation of installed central HPWH systems at five sites to allow for preliminary identification of high, medium, and low performing hot water system designs.

4

What's on the Horizon



Major Data Flows and Timeline





Snapshot of Federal and State Funded Building Decarbonization Programs

Launch Date	Program	Funding	Who Benefits	Measures
Oct. 2024	IRA HEEHRA Phase I / TECH Clean CA	\$80 Million	Low-to-moderate Income Households	Rebates existing single-family and multifamily air and water heat pumps, electrification, and appliance rebates
Nov. 2024	GoGreen Financing	\$30 Million*	All income households	Loan loss reserve and interest rate buydown to support home energy retrofit loans
Mid 2025	IRA TREC	\$9 Million	Trainees and Contractors	Pre-apprenticeship and apprenticeship programs and workforce development
Mid 2025	Equitable Building Decarbonization / HOMES Direct Install	\$413 Million* \$154 Million	Low-Income in Under-resourced Communities	No-cost decarbonization retrofits. All projects must replace gas heating/HVAC or water heating with heat pumps
Late 2025/ Early 2026	IRA HOMES Pay-For-Performance	\$102 Million	All income households	Existing residential. 15% overall energy savings
Late 2025/ Early 2026	IRA HEEHRA Phase II	\$152 Million	Low-to-moderate Income Households	ENERGY STAR® certified electric appliance rebates for existing residential
2026	Equitable Building Decarbonization Tribal Direct Install	\$30 Million*	CA Native American Tribes	Under development. Existing residential.

*state funded

6

NEW:
2025: ~\$40 M TECH Clean CA from Alison Canyon

Thank You

For more information: techcleanca.com

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Bruce Mast | Principal | Ardena Energy |
bruce@ardenna-energy.com



Appendix



Results To-Date 9-County Bay Area

Heat Pump Water Heaters

Single Family: 2,964 projects

Multifamily:

Projects completed and reserved: 248

Total units: 4,912

Heat Pump HVAC

Single Family: 7,641 projects

Multifamily:

Projects completed and reserved: 54

Total units: 434

HPWH Key metrics include:

- Electric panel work
- Installation times
- Emergency Replacements
- Avg. # of Bedrooms
- Avg Set Point:
- Thermostatic Mixing Valve

HVAC Key metrics include:

- Electric panel work
- Installation time
- Previous furnaces were fully decommissioned (rest set up to run emergency only)
- Replaced a previous Central AC

Market / Workforce



More Than Half of Water Heater Installs Are Done By DIYers or Friends/Family

- Based on the incidence survey of homeowners (n=149) who replaced their water heaters in the past two years, water heaters are installed by various individuals.

Installer	Percentage
Licensed contractor	32% (n=48)
Unlicensed handyperson	15% (n=23)
Family or friend	3% (n=4)
Respondent installed themselves (Do It Yourself)	50% (n=74)

- About a third of the 149 surveyed customers utilized a contractor who was registered with the CSLB to install water heating equipment.

Installation Cost Reductions



► DIY HPWH Installation & Maintenance Study

Active

2025/06

PROBLEM STATEMENT:

More than half of water heater installs are DIY but permitting and code requirements constrain DIY HPWH installations.

GOAL:

Simplify and expand feasibility of code-compliant DIY HPWH installations, building on new plug-in 120V HPWHs

SCOPE:

Develop resources to simplify code-compliant DIY HPWH installations.

Workforce Education + Training

Statewide Training

As of Aug. 2023: 1,873 people attended TECH Clean California training events

63% work in high unemployment zip codes



HVAC Training:
**National Comfort
Institute**



HPWH Training (2023):
**ESMAC* + HPWH
Giveaway**



Electrification
Training:
Electrify My Home



Multifamily Training:
**Association for Energy
Affordability**



► **Increasing Heat Pump Water Heater
Deployment**

Active

Install 150-160 120V HPWH
into the homes of plumbing
contractors.



Spur the clean heating market
through statewide strategies
and infrastructure

Create Statewide Infrastructure

- Streamlined incentive clearinghouse
- Standardized data collection and reporting
- Website with consumer and contractor facing resources

Drive consumer demand

- Statewide marketing campaign, strategic customer engagement

Activate the supply chain

- Contractor incentives
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- Trade ally engagement

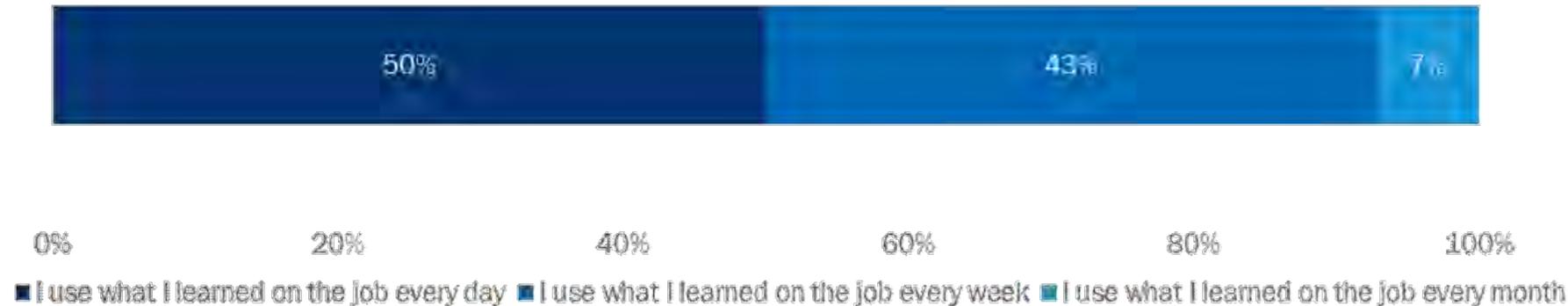
Topics of Interest and Areas for Expansion

Topic	Percent of Trainings that Reference Topic
Electrical components (currents, amps, voltage)	24%
Water Heating Codes	18%
Circuit Breakers	12%
HPWH Tank Corrosion	9%

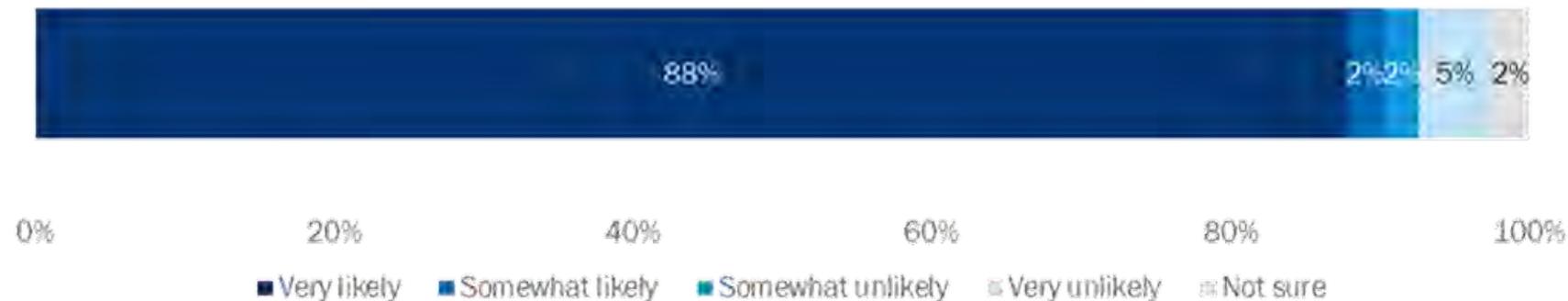
- Installers reported needing additional training on electrical components of heat pump water heater installations, service topics, and plumbing codes and regulations.
 - The training landscape analysis found few trainings that reference these topics.

Training Application in Work

Nearly all used what they learned frequently on the job



Most (36 of 41; 88%) are very likely to continue using knowledge in their current work



Quick Start Grant Profile:

Heat Pump Water Heater Retrofit Best Practices Guide - RHA

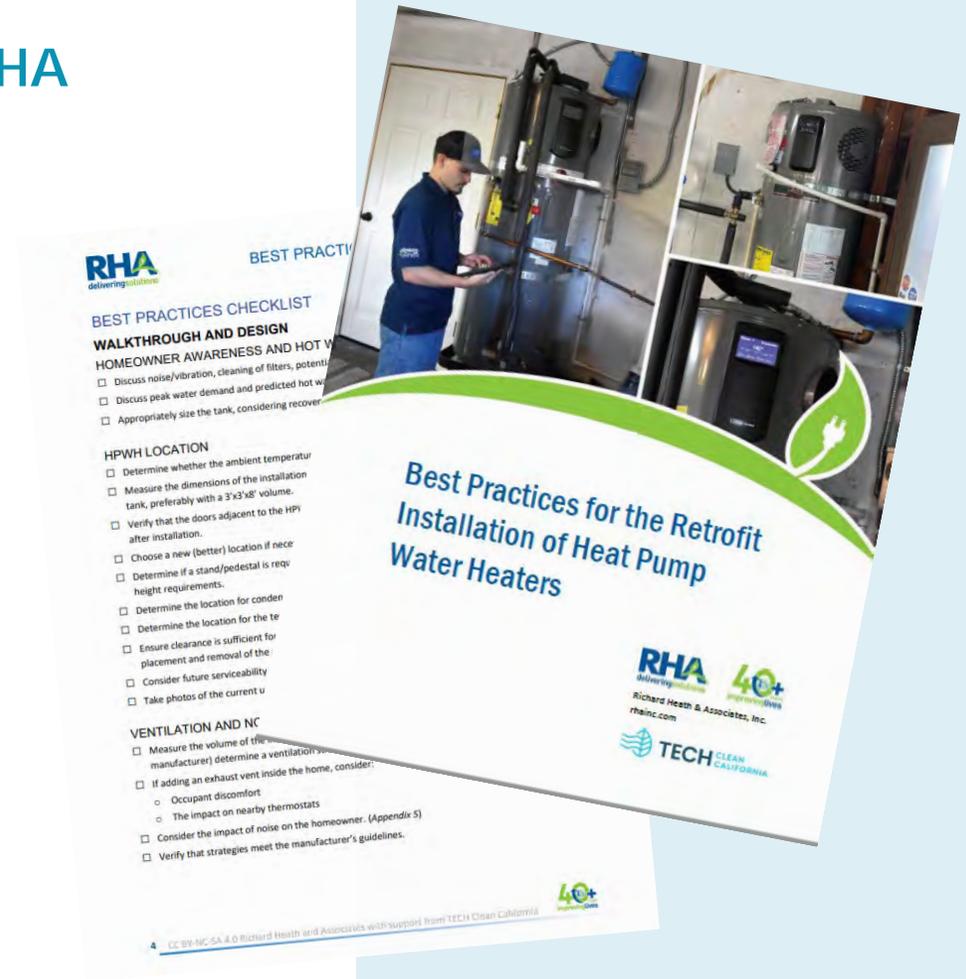
Project Objective: Ensure quality, replicable heat pump water heater retrofits across California by creating an open-source retrofit installation best practices and field guide, piloted with a small group of contractors.

August 2023 update:

- Best Practices document created using input from advisory group
- Available on TECH Clean California Contractor Hub

What's ahead:

- Interest by national research organizations in adapting this guide for a national audience
- Adapt best practices into a photo-based job aids



Contractors

25c Tax credits: Most contractors don't approach the tax credit conversation too much

- Eligibility can be confusing and contractors do not have visibility into customer tax liability, so can't guarantee tax credit
- Tax credits recognized more than eight months down the line.

Home Energy Rebate programs. More predictability with rebates; upfront payment, but still waiting on program design.

TECH Clean California / SGIP incentives. Excited to participate. Incentives “open up the door” to customer conversations.

Simplicity is key. Prefer “flattened” incentives, centralized application system, broad eligibility.

Our Takeaways:

- Prefer centralized system/platform
- Clear rules that don't change and are consistent across programs
- Spiffs less important than predictability
- Short payment turnaround is key. Low financial tolerance for long repayment periods.

Distributors

Combination of market drivers are increasing their AC:HP stocking ratio

Distributors are a key partner in heat pump programs.

- They are intimately familiar with the product, the market, and program requirements and are main avenues for education for contractor base.

Substantial increase customer demand for heat pumps, specifically highly-efficient heat pump

- Uptick attributed to recent heat pump media and IRA incentives (\$2000 25C tax credit). May take some time for the 25C tax credit to make larger impacts.
- Some wariness that customers perceive heat pumps as a “panacea.”
- More nuanced customer education necessary (what measures to prioritize first, etc.)

Codes and Standards also driving stocking decisions

- Ultra-low NOx (ULN) standards also contributing to heat pump adoption.
- New 2023 DOE product standards motivated distributors to get rid of AC stock in 2022 and switch purchase orders to heat pumps.

IRA Rebate Programs - hearing lots of buzz / excitement, but not yet a driver.



Manufacturers

Insights on ability of manufacturers to convert existing natural gas manufacturing lines to electric

- Some manufacturers are retooling plants to be 100% heat pump focused
- Manufacturers do not see an issue with production capacity and are confident they can meet demand
- Price inflation is similarly affecting heat pumps, furnaces, and gas water heaters
- Some manufacturers are dropping less efficient model lines due to IRA eligibility requirements (25C and home energy rebate programs)
- Main focus of manufacturer marketing dispel old assumptions about heat pumps – i.e., heat pumps are appropriate and effective in cold climates.

Our Takeaways:

- Provide manufacturers with forecasted units the programs will support to ensure capacity
- Capacity / product quality has been hugely increased but is not instantaneous - manufacturers need to know what to plan for
- Three to six-month headwinds on eligibility changes to retool production
- Consider program goals when determining eligibility requirements

Financing



Affordability - Financing

PROBLEM STATEMENT: Conventional finance options are unaffordable or inaccessible to low-income and credit-challenged customers.

GOAL: Investigate options for expanding customer access to affordable financing for electrification upgrades.



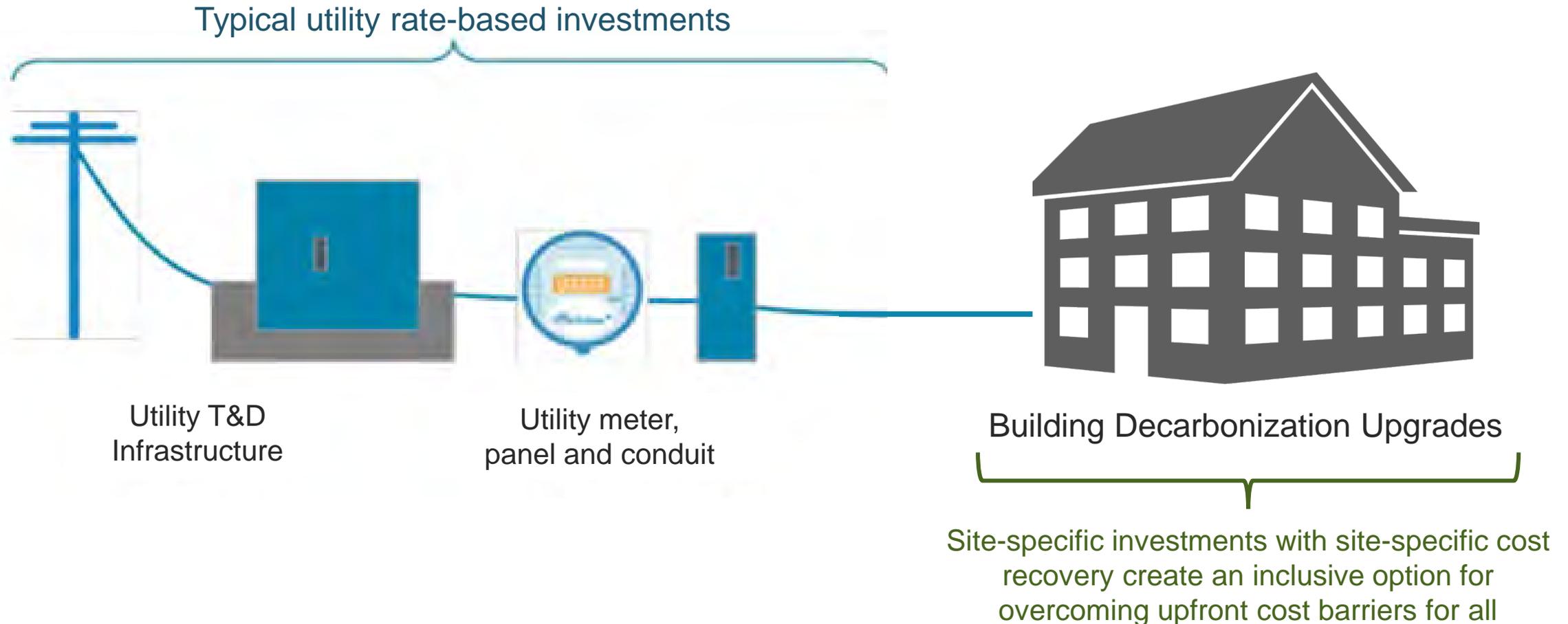
SCOPE:

- **Inclusive Utility Investment (IUI).** TECH and Silicon Valley Clean Energy have partnered to launch financing pilot to **test key IUI design elements.** Results expected in 2026.
- **CalNext market study** investigating opportunities and gaps for expanding public heat pump financing programs. Promising options include:
 - **contractor point-of-sale lending**
 - **equipment leasing**
 - **combined solar and electrification financing**
- Results will be published in December 2024



Q. What are Tariffed On-Bill Investments?

A. Site specific investments on tariffed terms with on-bill cost recovery



Tariffed On-Bill vs. On-Bill Financing

		OBF	IUI
Program Attributes	• Cost recovery is through a fixed charge on the utility bill	✓	✓
	• Participant accepts an opt-in utility tariff <u>tied to the location</u>		✓
	• Charge applies automatically to successor customers until cost recovery is complete		✓
	• Estimated savings <u>must exceed</u> cost recovery charges		✓
Customer Benefits	• No upfront participant cost for cost effective upgrades	✓	?
	• No credit or income qualification required		✓
	• Renters are eligible		✓
	• Estimated savings <u>exceed</u> cost recovery charges		✓
	• Payments end if upgrade fails and is not repaired		✓

Other Topics



Time and Cost Savings Opportunity: Same-Day Permitting

TECH analysis of permit issuance times for 1,143 TECH HPWH incentive claims in 100 Authorities Having Jurisdiction (AHJs, mostly Sacto & SF Bay), 12/21 to 4/23

- AHJs commonly issue same-day permits for “like-for-like” replacements of methane DHW
- Ave. application to permit issuance was 5.91 days
- 25 AHJs (49%) process $\geq 75\%$ of HPWH permits in <1 day

Ave. time to permit issuance	Claims (n=774)	AHJs (n=51)
Same day	527 (68%)	16 (31%)
>1 day	247 (32%)	35 (69%)



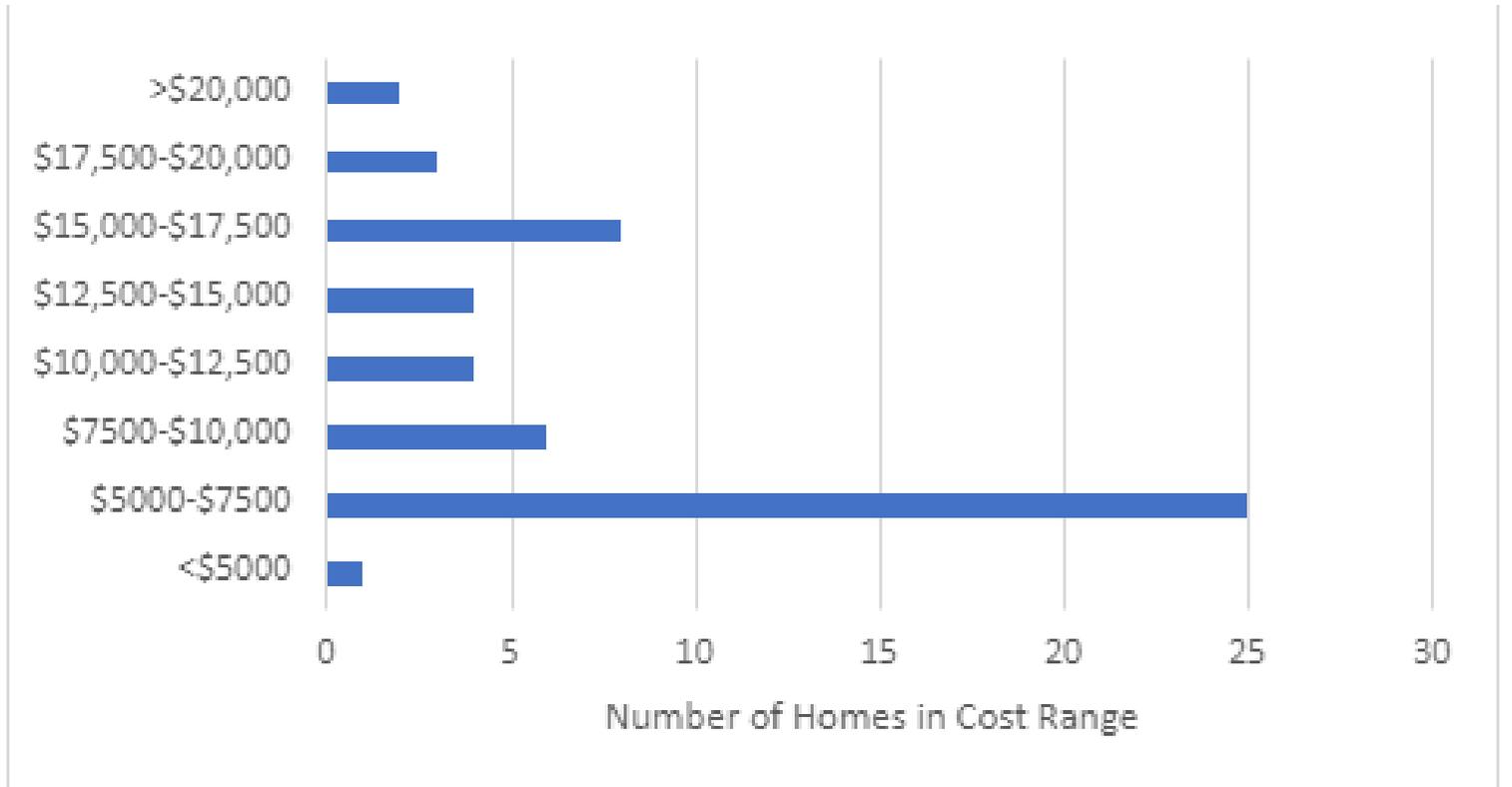
Long permit times are common and complicate emergency replacements. **Same-day permitting is possible.**

See <https://techcleanca.com/pilots/permitting-pilot/>

Pilot Profile: Low Income Pilot

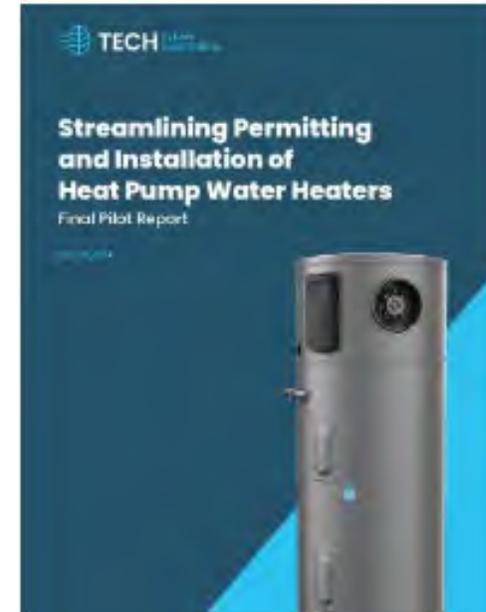
San Joaquin Valley Home Remediation Data Analysis

- Collaboration with SJV DAC Pilot Project offers up additional home remediation funding
- 54 homes funded: 26 single-family + 28 mobile homes
- New report on the type, frequency, and cost of remediation measures published:
<https://techcleanca.com/pilots/low-income-fuel-switching/>



Permitting Pilot – Recommendations

- Increase distribution of permitting educational materials through formal and recognized and trusted channels
- Equip building department staff at all levels with online, on-demand, and in-person training and resources
- Direct experiential learning opportunities tailored to address the specific knowledge gaps of building and permitting departments
- Conduct targeted outreach to jurisdiction with the highest volume of TECH Clean California heat pump water heater claim submissions to identify additional best practices
- Conduct targeted interviews with contractors installing heat pump water heaters to increase understanding of permitting barriers.

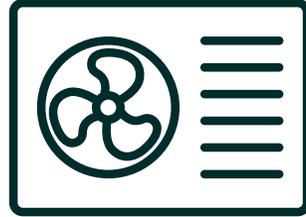


Downloadable Permitting Resources

The Permitting Pilot has developed a suite of resources to help guide you through standard permitting and energy code requirements for your HPWH project:

- **HPWH Permit Supplement Template**
- **Electrical Load Estimator**
 - This Estimator includes two calculators, the first being a comprehensive load calculator that assists in calculating the Service Load of a dwelling. This load calculator is compliant with 220.82 of the Electrical Code. The second assists in calculating the Maximum Existing Load per Code Reference 220.87. It is recommended only building professionals familiar with the energy code use the Service Load Calculation sheet.
- **2022 HPWH Building Code Assistance Sheet**
 - BayREN and TECH Clean California offer this summary of California state level building code requirements for the installation of heat pump water heaters. This is intended to assist permit applicants and building department staff to submit, review, approve, install, and inspect heat pump water heater alterations in single family homes.

Install Costs, Space Constraints, Timing, and Operational Costs (HVAC)



► Multifamily In-Unit Heat Pump

► Emerging “Micro” Heat Pumps: Testing and Heating Performance Metrics

Complete

Final
Report

2023/11

Active

2024/12

- Advantages: potential lower costs, speed and ease of installation, improved aesthetics, occupant controlled space conditioning, and allows incremental displacement or replacement of central or in unit heating and cooling systems.
- New plug-in 120V window heat pumps and other in-unit packaged heat pumps may serve as important technical solutions for multifamily units with limitations of existing electrical panel and service capacity
- Modeling results demonstrate that in-unit heat pumps can reduce energy usage (20 – 40%) and potentially reduced utility costs in some instances. Additional modeling of proposed equity-based rate structures, time-of-use rates, and local natural gas and electricity pricing is needed.
- Split incentive between renter and tenant needs to be addressed

Tariffed On-Bill could offset some installation costs for some customers (example)

Climate Zone 3, Customers with AC	Impacts from Heat Pump Space Heater + Heat Pump Water Heater + Energy Efficiency	
	Market Rate	Low Income
Total Project Cost: Heat Pump Space Heater + Heat Pump Water Heater + Energy Efficiency	\$26,586	\$26,586
Incentives	\$12,420	\$22,035
Net Project Cost	\$17,366	\$4,551
Annual bill savings	\$462	\$431
Tariffed On-Bill contribution to principal	\$3,154	\$2,944
Tariffed On-Bill monthly service charge	\$30.81	\$28.76
Net annual bill savings	\$92	\$86
Funding Gap / Copay requirement	\$14,212	\$1,607
Annual Gas Savings (Therms)	500	500
Annual Electricity Savings (kWh)	-1,606	-1,606
Lifecycle GHG reductions	25.24	25.24

- Tariffed On-Bill investments could defray installation costs for customers with high bill savings opportunities (generally, customers with high air conditioning loads, ~ 10-20% of Bay Area customers)
- For those customers Tariffed On-Bill could contribute ~\$2-6k towards total installation costs
- CPUC seeks joint utility proposal for Tariffed On-Bill programs by May 2024. Deploy pilots in 2025?