Sunnyvale

Encouraging Heat Pump Water & Space Heating

2018 Council Study Issue (ESD 18-01)

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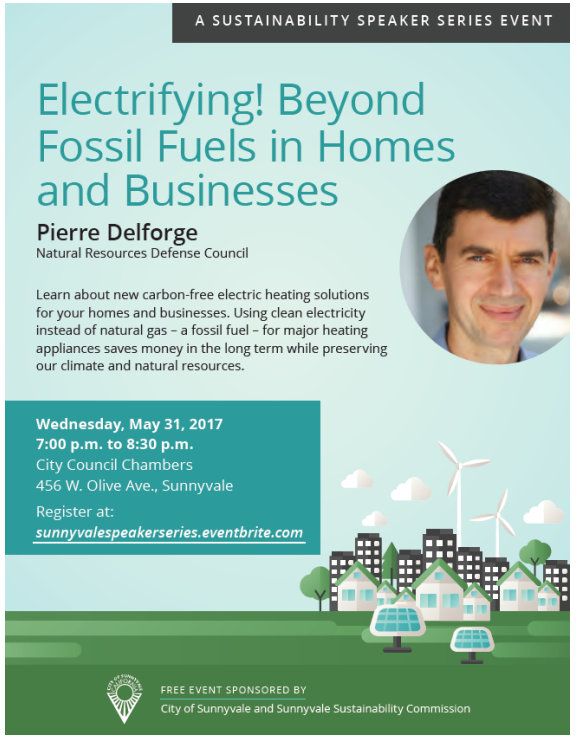
Overview

- Background and Context
- Overview of Heat Pump Technology
- Costs & Benefits
- Approaches to Encouraging Heat Pump Technology
- Discussion

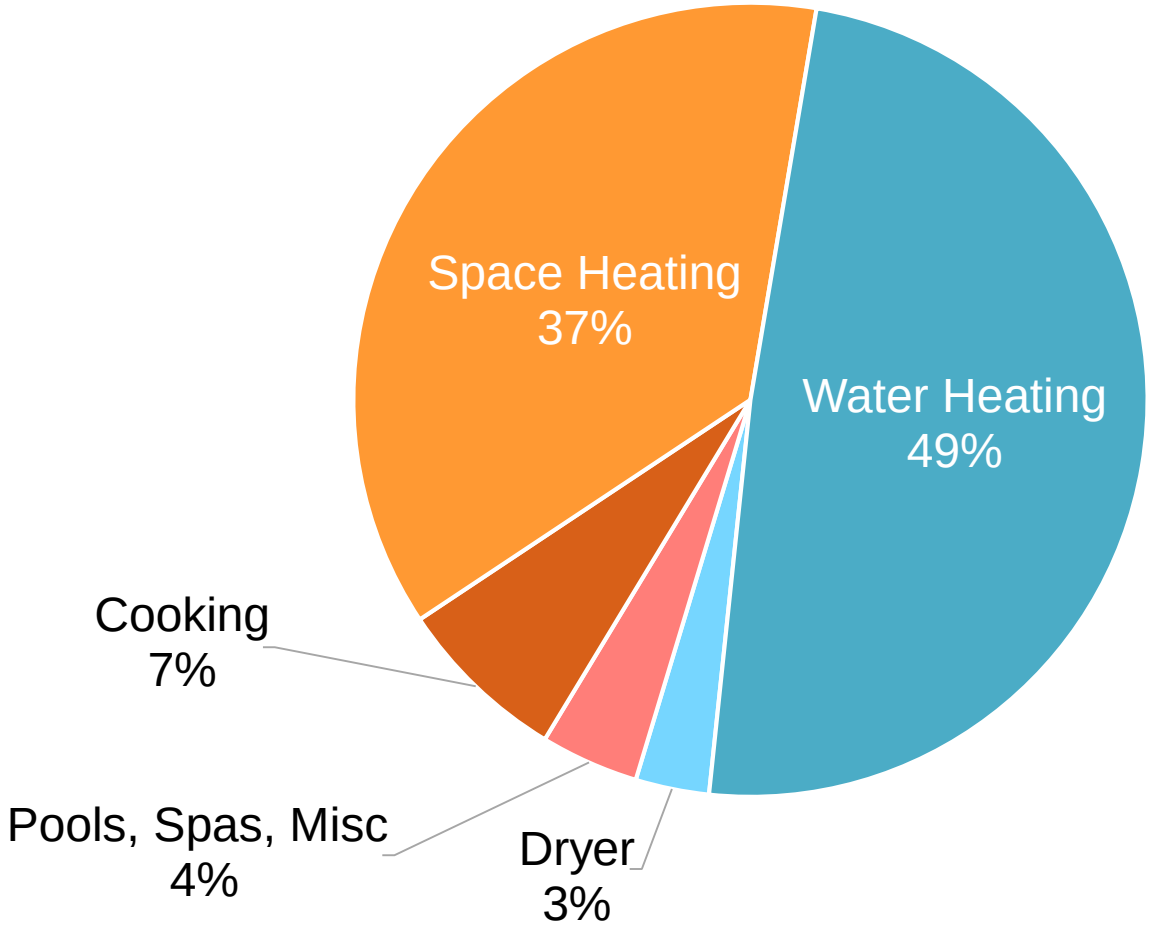
Background

- Recap of Study Issue
  - Inspired by Sustainability Speaker Series event
  - Proposed by Sustainability Commission
  - Approved by Council at 2018 Study Issues workshop
  - Lead Department: ESD
  - Support Department: Community Development
- Silicon Valley Clean Energy (SVCE)
  - Conducted the study
  - Beneficial for all SVCE member agencies
- Interest growing across Bay Area, California, and US



GHG Benefits of Heat Pump Technology

CA Residential Natural Gas Consumption

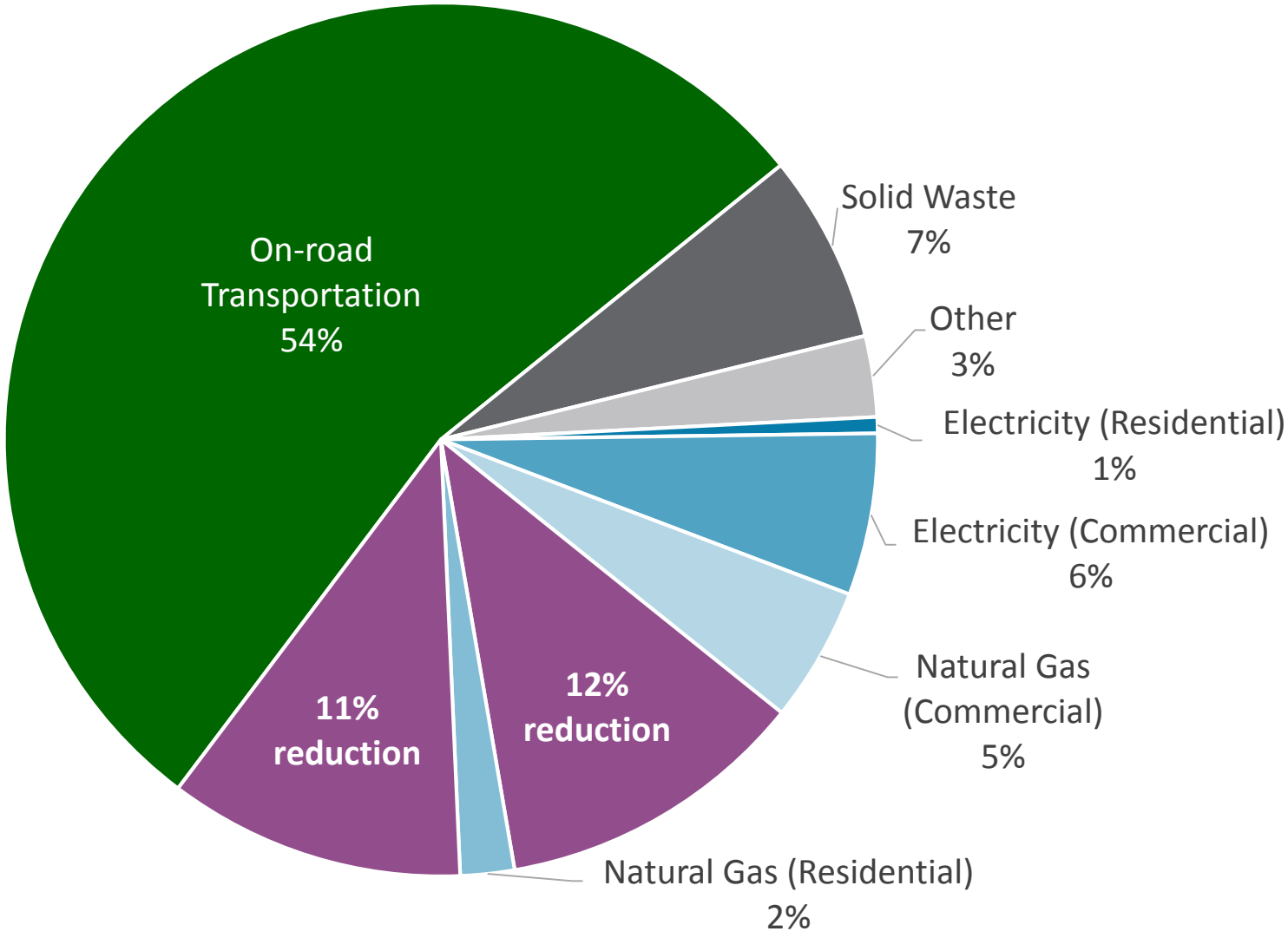


- Water and Space Heating =
  - 86% of residential gas usage
  - 68% of commercial gas usage

Sources: 2009 California Residential Appliance Saturation Study; 2006 California Commercial End Use Survey; Building an Electric Future, K. Rider, California Energy Commission (2018)

GHG Context

- What if we replace all water & space heating with heat pump technology?
  - 23% Reduction
  - 165,000 MTCO2e Reduction



Climate Action Playbook coming soon

Six Key Strategies

Promoting Clean Energy

Decarbonizing Buildings

Decarbonizing Transportation & Sustainable Land Use

Managing Resources Sustainably

Empowering Our Community

Adapting to a Changing Climate

Get your game face on!

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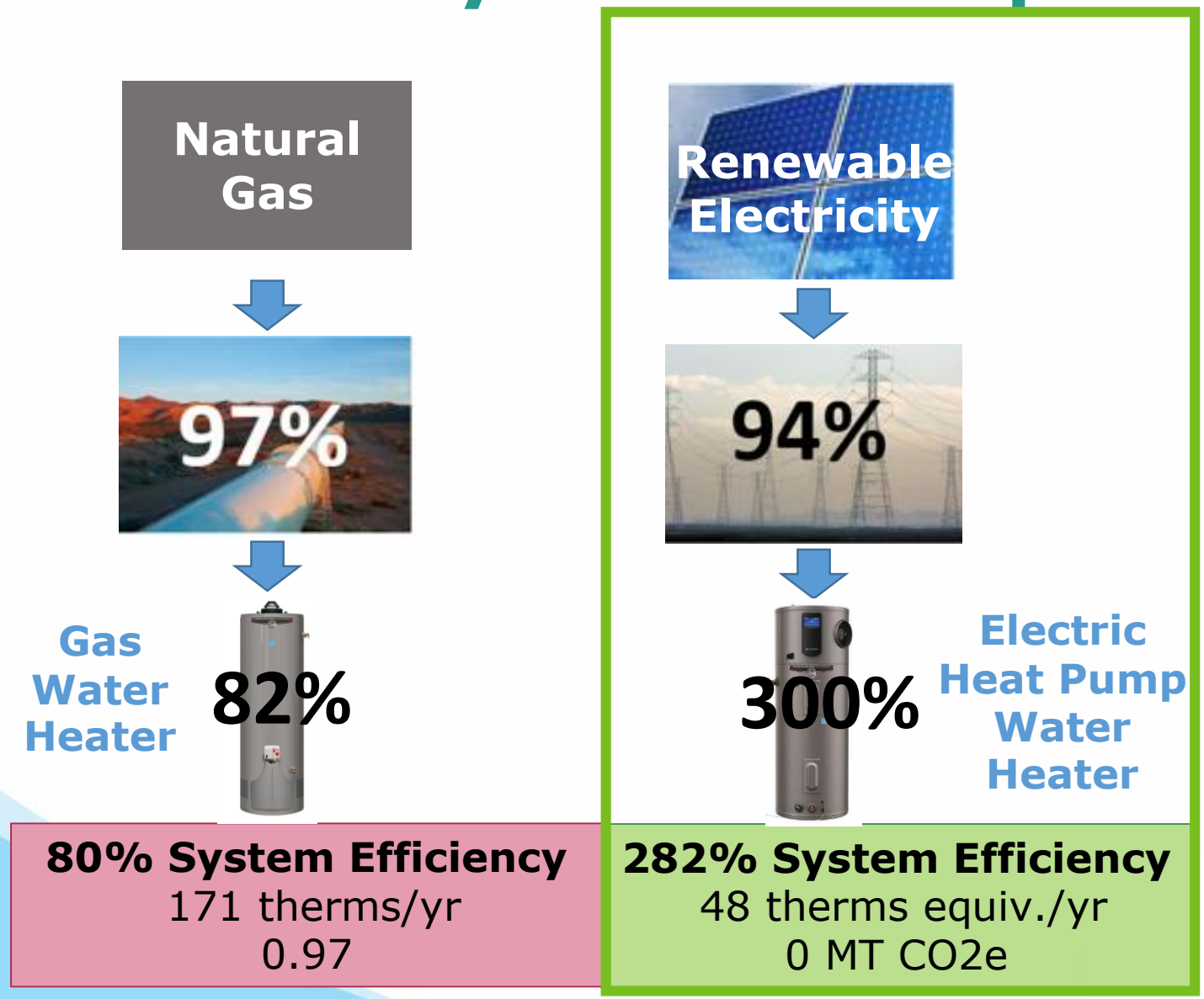
Encouraging Heat Pump Water & Space Heating Study Findings

Preview – Study Findings

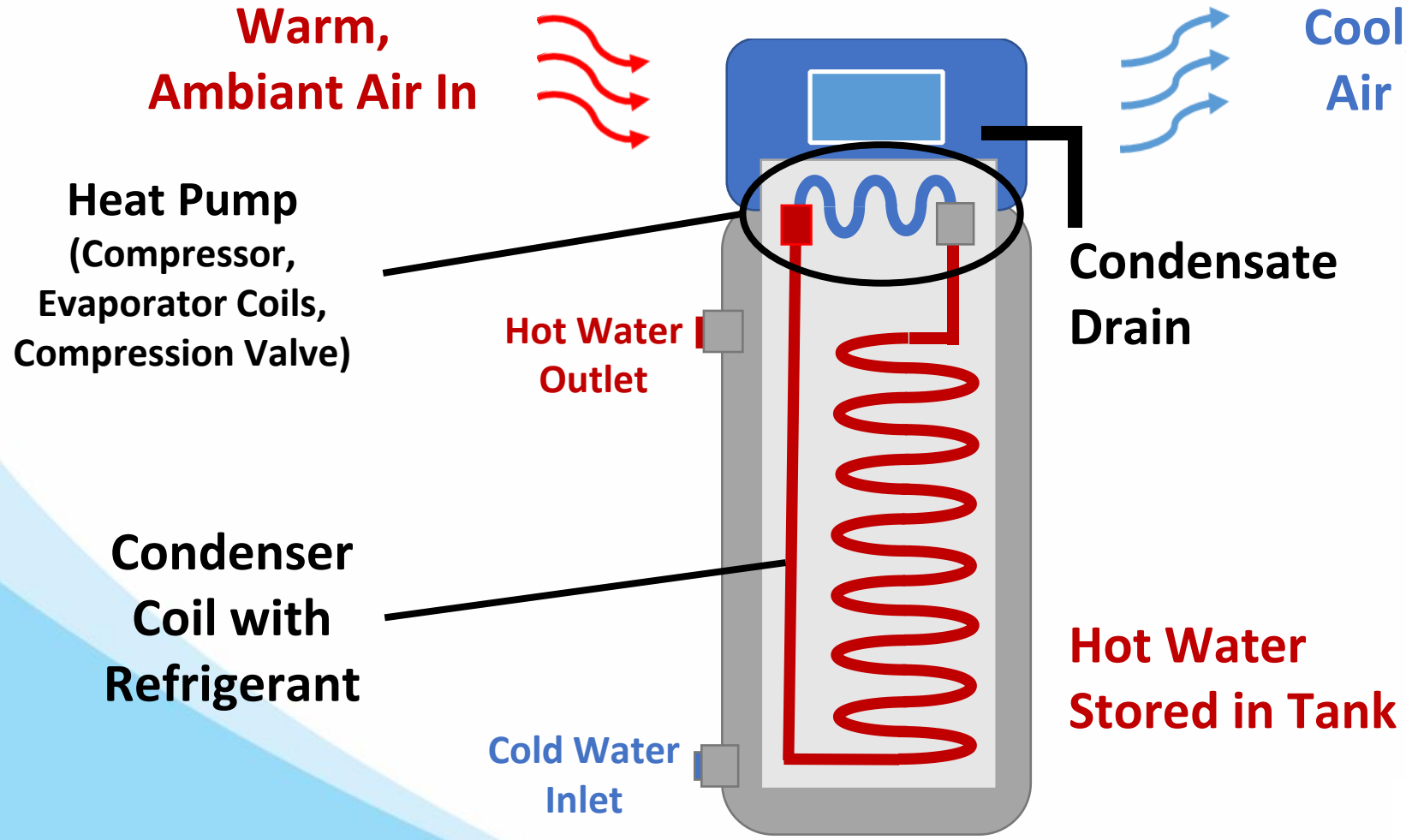
- Heat pumps are highly-efficient, proven technology dominating the market in most other parts of the world
- Replacing natural gas with heat pump electric appliances powered by clean, renewable electricity is essential to decarbonize buildings
- Heat pump appliances can be economical in our region, especially when:
  - installed in new construction
  - programmed to use electricity at off-peak times
  - paired with on-site solar PV
  - replacing electric resistance appliances
- SVCE is a ready partner and initiating a pilot program.

Renewable Electricity + Heat Pumps = Future



Source: Building an Electric Future, K. Rider, California Energy Commission (2018)

Heat Pump Technology Overview



Heat Pump Water Heater

Visual of Heat Pumps Appliances

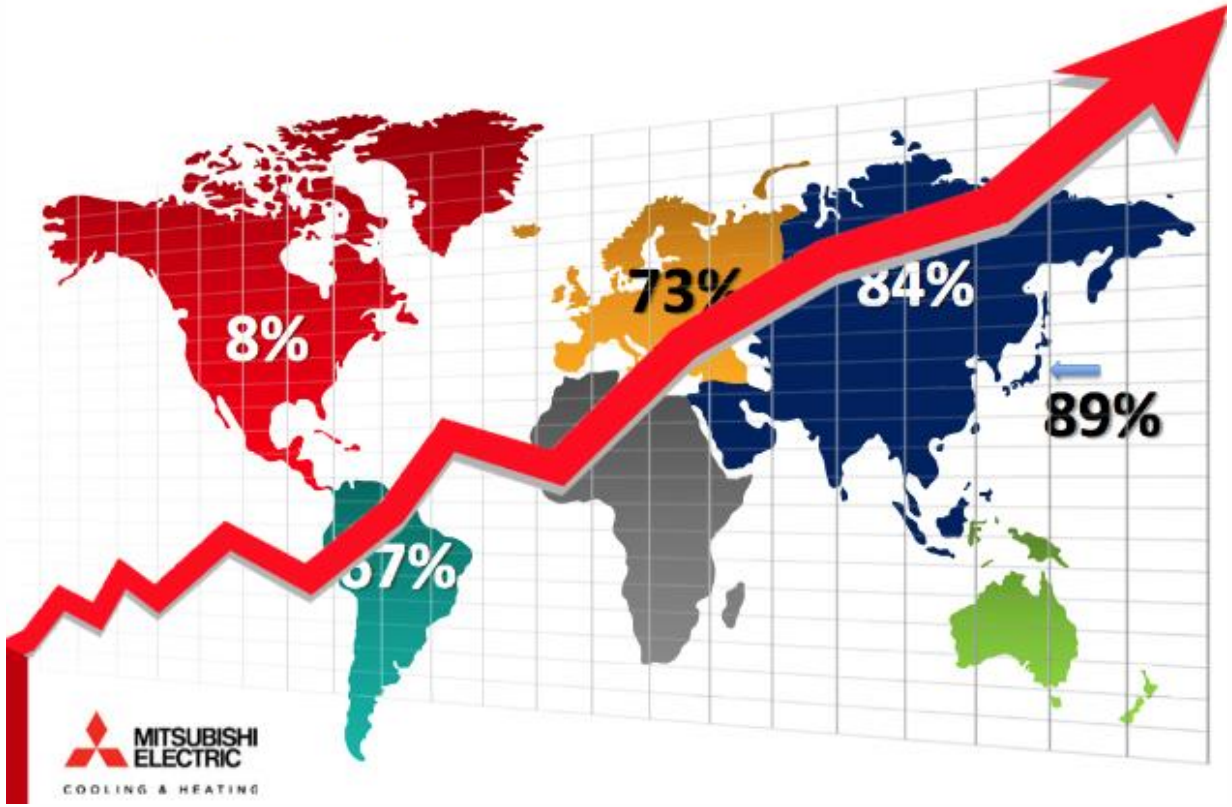
Space Heating/Cooling

Water Heating

Heat pump appliances look similar to standard household appliances

Global Market for Heat Pumps

- Proven technology, around for decades
- Space heaters/AC dominate market across most parts of the world
- In U.S., adoption is lower but gaining market share

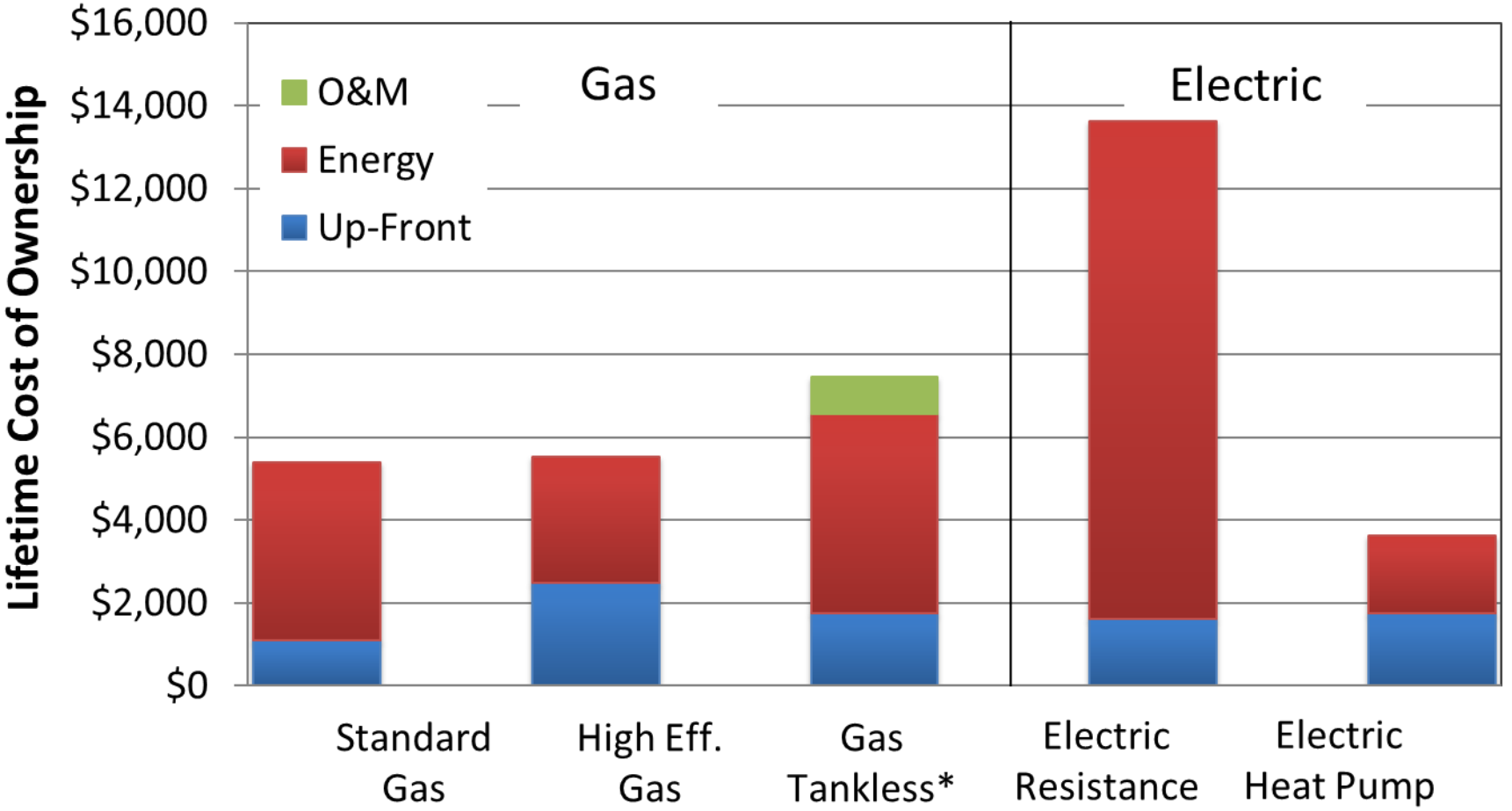


Heat pump space heating/AC worldwide

Economics of Heat Pump Appliances

- To assess economics, SVCE conducted:
  - literature review
  - cost-effectiveness analysis of heat pump vs. natural gas appliances
- Cost-effectiveness analysis accounted for:
  - All up-front and ongoing costs over the appliance lifetime for average household
    - Up-front: equipment, sales tax, permitting, installation
    - Ongoing: energy, operation & maintenance (O&M)
  - Pairing heat pumps with on-site solar photovoltaics (PV)
  - Used SVCE electricity mix and local retail rates, sales tax, permitting costs
  - Appliance selection & performance optimized for SVCE cities, climate

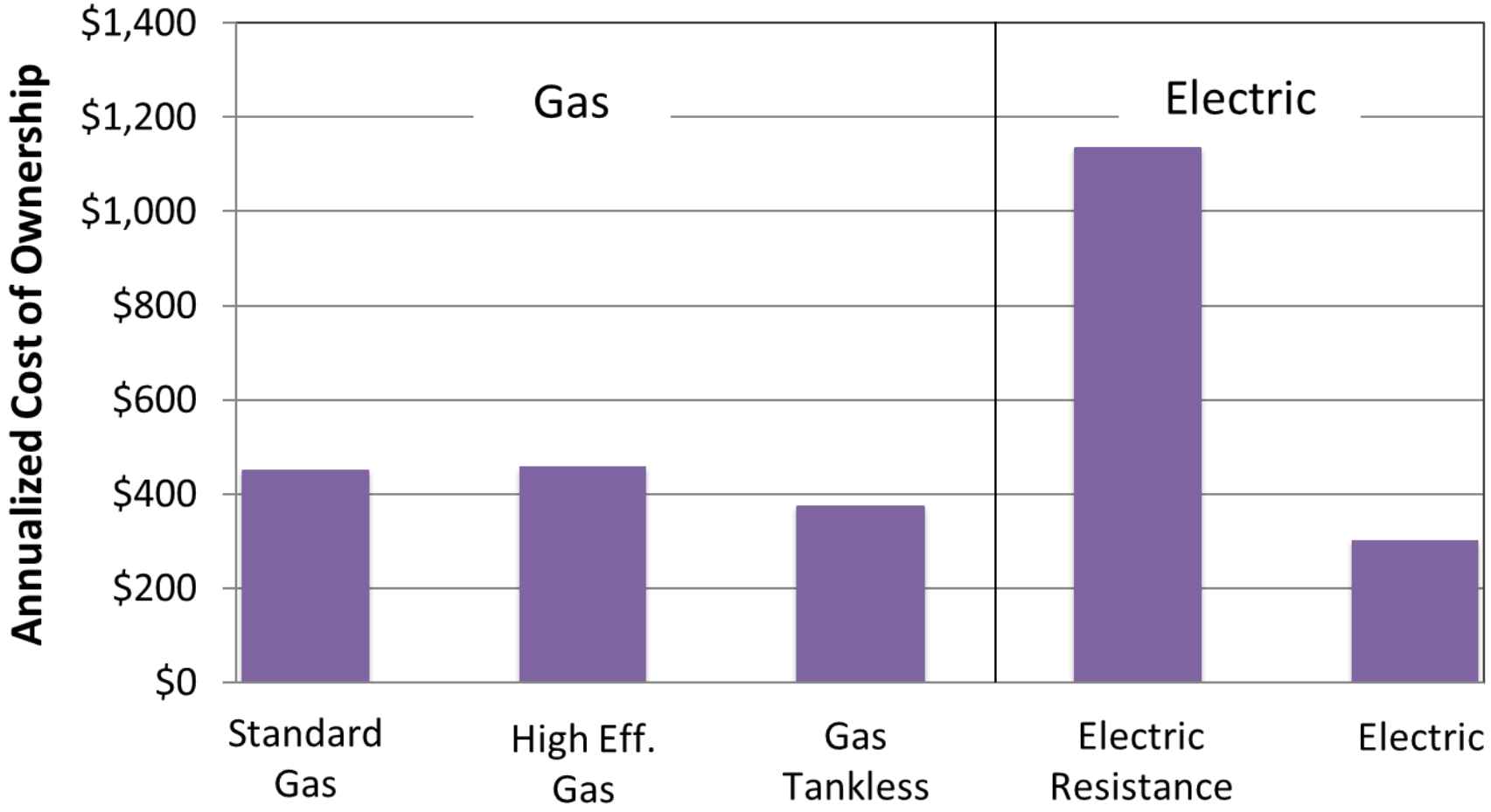
Residential Water Heating



**Gas tankless have longer estimated life; annualized costs shown on following slide.*
^ Includes federal tax incentive and PG&E rebate.

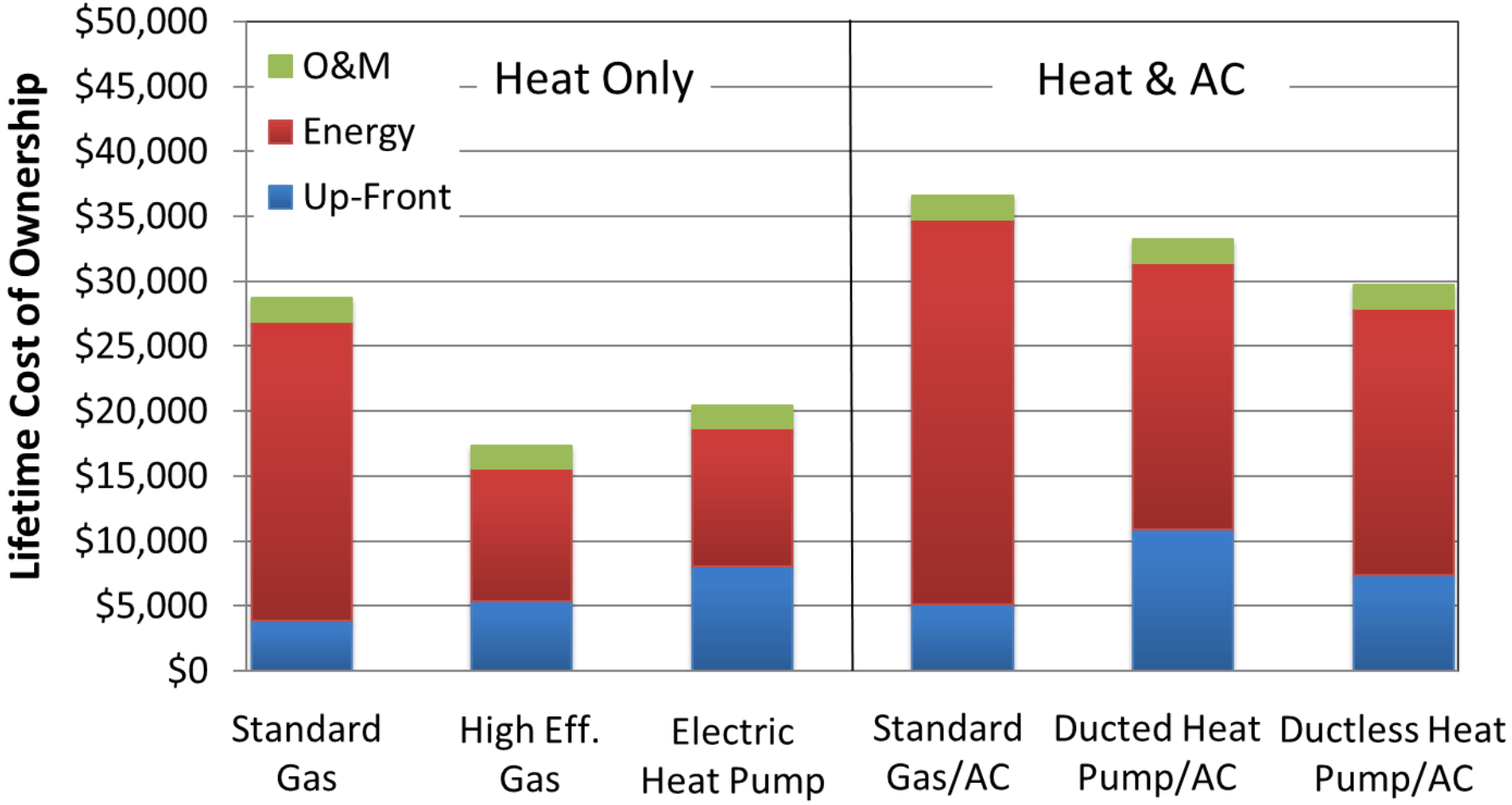
Heat pump water heaters have higher up-front but lower ongoing costs.

Residential Water Heating



Heat pump water heaters can be most cost-effective option for an average household.

Residential Space Heating



Heat pump space heating has higher up-front but lower ongoing costs. Can be most cost-effective option, especially when combined with AC.

Barriers to Retrofits

- Significant additional costs to retrofit a building:
  - $500-$2,000 for wiring dedicated circuits to appliance locations
  - $3,000-$5,000 for potential electrical panel upgrade
- Unique needs of air-source heat pumps complicate retrofits, including requirements for:
  - condensate drain
  - ambient air surrounding appliance
- Appliances typically replaced on emergency-basis with in-kind technologies

Sources: Promatcher, online electrician service report /City of Palo Alto Residential Electrification Study (2015); Decarbonization of Heating Energy Use in California Buildings, Synapse Energy Economics (2018)

Advantages of All-Electric New Construction

- Direct cost savings of $5,000-$8,000 from no utility connection, plumbing for natural gas
- Simpler design and permitting given single fuel
- Design optimized for electric heat pump appliance requirements
- Improved indoor air quality from dehumidification, eliminating indoor combustion
- Managing electric building loads can provide grid services, including emissions reductions, enhanced reliability
- Additional, modest cost savings from no appliance venting

Sources: California Air Resources Board, https://www.arb.ca.gov/research/indoor/combustion.htm; Decarbonization of Heating Energy Use in California Buildings, Synapse Energy Economics (2018)

Cost-Benefit Analysis Conclusions

- Heat pump appliances can be economical in our region, especially when:
  - installed in new construction
  - programmed to use electricity at off-peak times
  - paired with on-site solar PV
  - replacing electric resistance appliances
- All-electric buildings offer significant health, safety and comfort benefits
- Significant economic and non-economic barriers for retrofitting existing buildings

Public Outreach

Encouraging residents to plan ahead for installation of heat pump water and space heating systems involves a number of important considerations:

- building electrification context
- policies, programs and outreach goals
- target audiences (contractors, plumbers, electricians, solar installers, designers, architects, engineers, property managers, residents and business owners)
- outreach approach and channels

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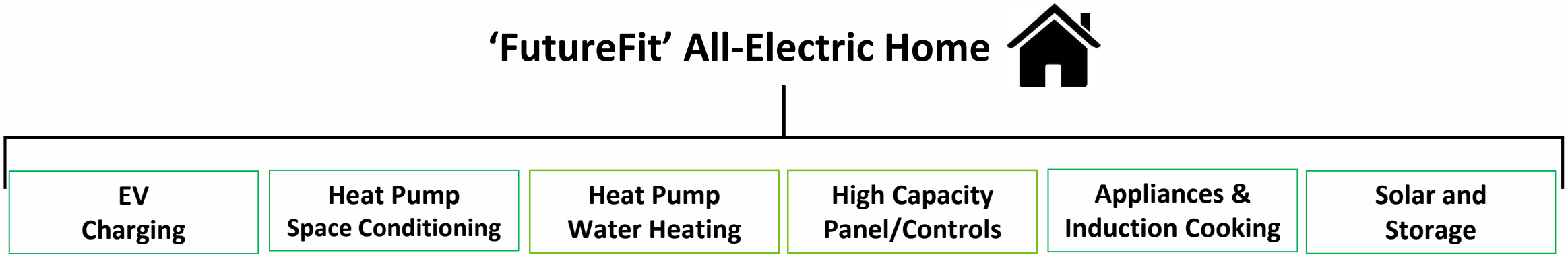
Building Electrification Context



Heat pump space and water heating are key elements in all-electric construction

- all-electric construction emerging in building policies and codes in CA
- market barriers include lack of awareness, trade skills, building infrastructure readiness
- complexity and cost vary widely in new construction, remodel and retrofit
- outreach should communicate all-electric vision

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Local Policy – Example Financial Incentives

Incentive Type	Offered By	Value	Result
RETROFIT			
Elec Resistance → Heat Pumps	PG&E, SMUD, CPUA, Silicon Valley Power	$300-$500	Mixed, despite easiest scenario
Natural Gas → Heat Pumps	CPUA (open), SMUD	$1,500	Minimal, incentive limited to appliance
Natural Gas → Heat Pumps + Service Panel	SMUD (opened mid-2018), SVCE (coming 2019), San Jose/SVEW (coming 2019)	$3,000-$4,500	Higher adoption expected
NEW CONSTRUCTION			
Heat Pumps	n/a	No incentives available	Cost effective already

Local Policy – Key Levers

Retrofit

- Financing options
- Permitting improvements
  - Streamlined
  - Lower cost
  - Expedited

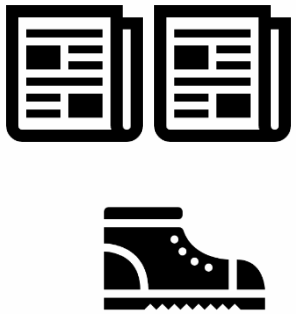
New Construction

- Increased Floor Area
- Access to financing for meeting green building standard
- Reach Codes promoting electric appliances

Local Policy - Permitting

Business as usual

- Over the Counter
- Average $265, circumstantial
- Two tasks (one electric, one plumbing)
- Rarely seen



Differentiators

- Online applications
- Flat rate for HPWH
- Single task (combined application)
- HPWH-specific trainings
- HPWH inspection checklists

Given overall low volume, a major increase in adoption will likely warrant additional inspector and permit reviewer training.

Heat Pump Water Heater Pilot

Objectives

- Clear customer economic, health, and environmental benefits of HPWH
- Inclusion of HPWH in larger campaign focused on beneficial electrification
- Education and Awareness for consumers, installers, and inspectors
- Increased support within the supply chain

Proposed Pilot (Launching early 2019)

- 2 years; HPWH + Service panel Upgrade costing less than gas retrofit
- Incentive: $3,000-$4,500
- Target: 90 Market rate + 10 installations in CARE/FERA customers
- Includes several outreach elements:
  - Customer-facing Benefits Guide
  - Building Inspector Trainings & Community Workshops
  - Pro-active sales channel engagement
  - Incentives encouraging supplier participation

Summary

- Heat pumps are a viable technology growing in market share worldwide
- Cost-effective for electrifying space and water heating, especially for new construction or when paired with solar
- Key barriers for retrofits include:
  - High cost of wiring and panels
  - Space considerations
  - Lack of preparedness for emergency replacements
- SVCE conducting incentive-based pilot program to specifically target cost barriers

Proposed Next Steps

- Staff Proposed next steps:
  1. Decarbonizing Buildings is a Climate Action Playbook Strategy
  2. Evaluating Electrification and Heat Pump Technology as component of Green Building Program
  3. Staff working with SVCE on pilot program, potential “reach code”, and outreach approaches
  4. Information Only RTC to Council
- Council Feedback
  - Are we focused on the right actions to encourage heat pump technology?
  - Is there more information needed to guide decisions?