

Building the Future: Electrification Strategies for Contractors and Architects



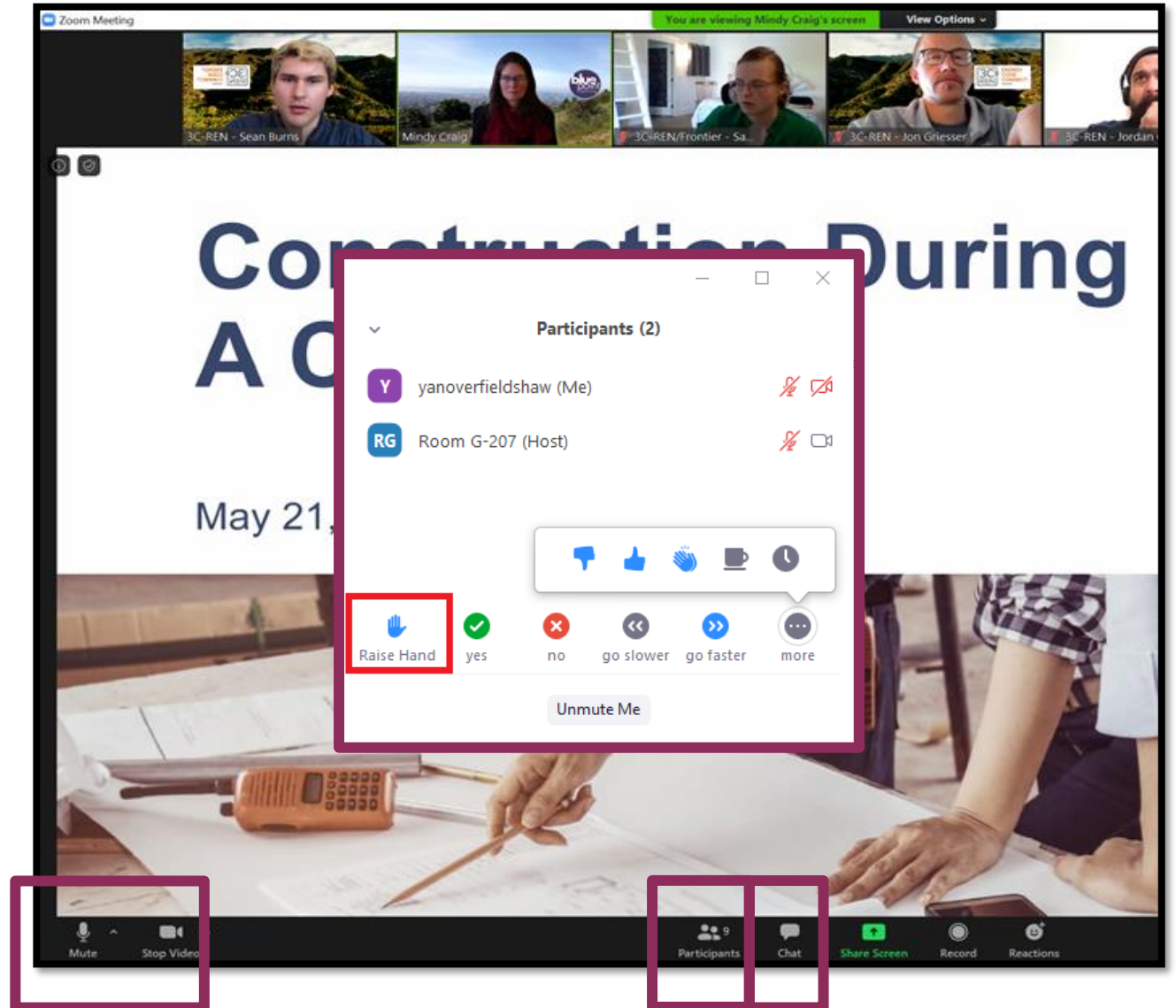
Larry Waters – Electrify My Home

August 23, 2024



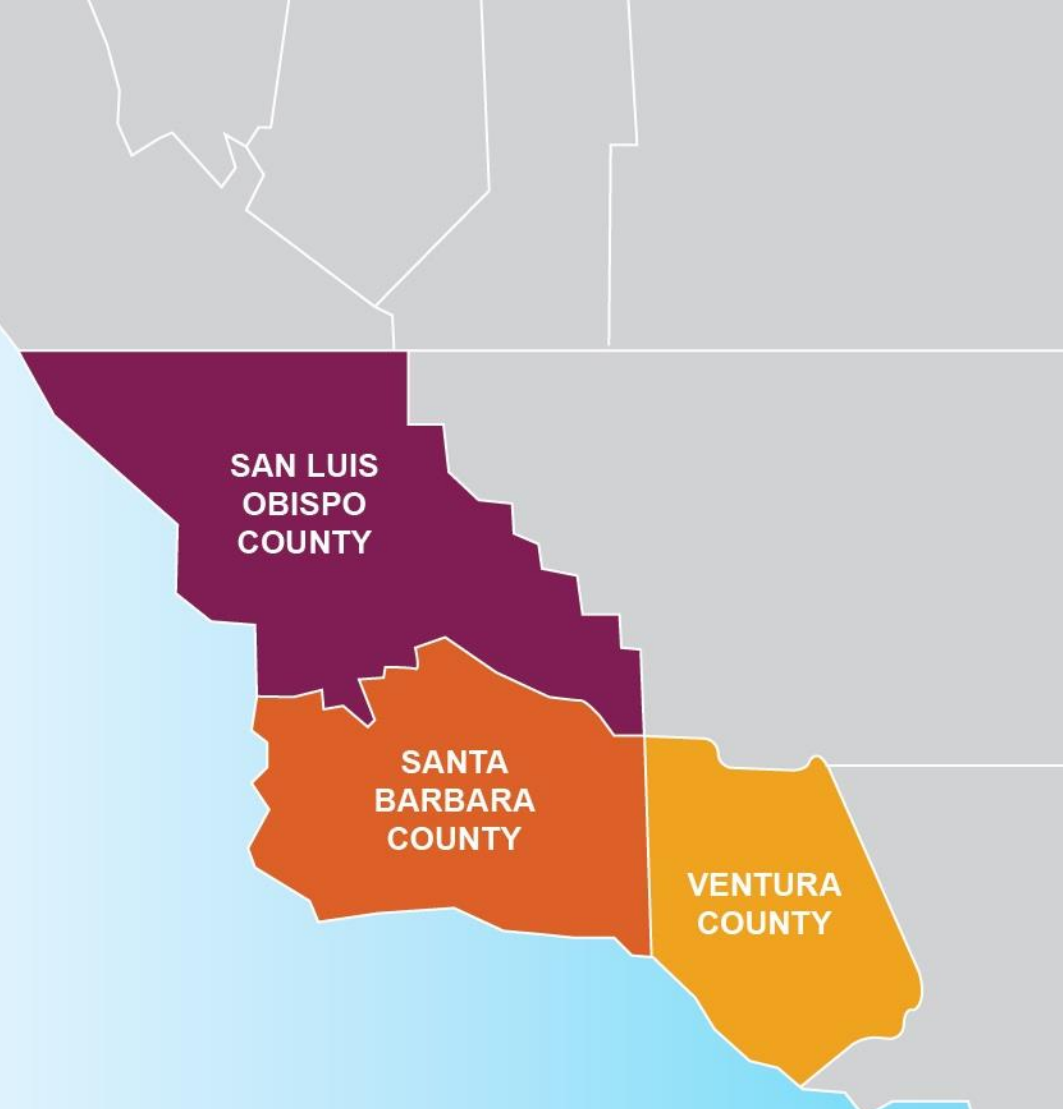
Zoom Orientation

- Please be sure your full name is displayed
- Please **mute** upon joining
- Use "Chat" box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be **recorded** and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
 - **Building Professionals:** industry events, training, and energy code compliance support
 - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region



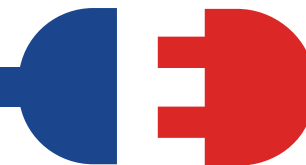
3C-REN Programs

- **Energy Code Connect (ECC)**
 - Industry Trainings and Regional Forums
 - Energy Code Coach: Title 24 Compliance Support Hotline (805) 220-9991
- **Building Performance Training (BPT)**
 - Industry Trainings & Certification for current and perspective building professionals
 - Helps workers thrive in an evolving industry
- **Home Energy Savings (HES)**
 - Flexible Home Energy Upgrades
 - Multifamily (5+ units) & Single Family (up to 4 units)



Agenda

- ✦ Intro to the “Trade Pro” Series
- ✦ Electrification market in California and PG&E Service Territory
- ✦ Market opportunities
- ✦ Whole-home Electrification planning
- ✦ Importance of HVAC & Duct design, install, and commissioning



Electrify My Home – Electrification Pioneers

Our Mission:

*To provide the **most efficient** cost-effective electrification solutions to California homeowners, to practice **good stewardship** of the electrical panel, and to **train and influence** other contractors to do the same.*



ELECTRIFY
MY HOME

Electrify My Home Trade Pro Series

- **Goal – provide a crash course on Electrification**
- **Let you know how we got here and where we're going**
- **Point out enormous business opportunities**
- **Open your eyes into better ways to serve your customers**

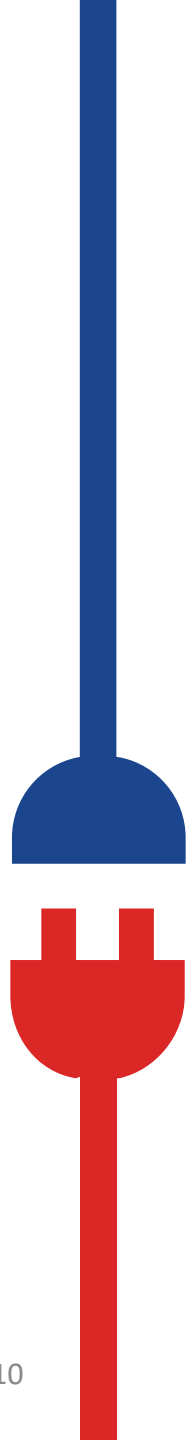




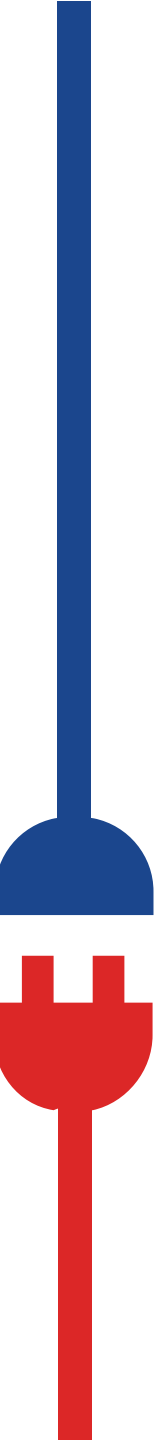
#ElectrifyEfficiently

Areas of Focus

- 🔌 Building electrification (single family residential)
- 🔌 HVAC & water heating (heat pumps)
- 🔌 Overcoming home electrification barriers
- 🔌 Approaches that optimize for comfort, efficiency, resilience, and low operational cost
- 🔌 All audiences will benefit, especially contractors and industry professionals

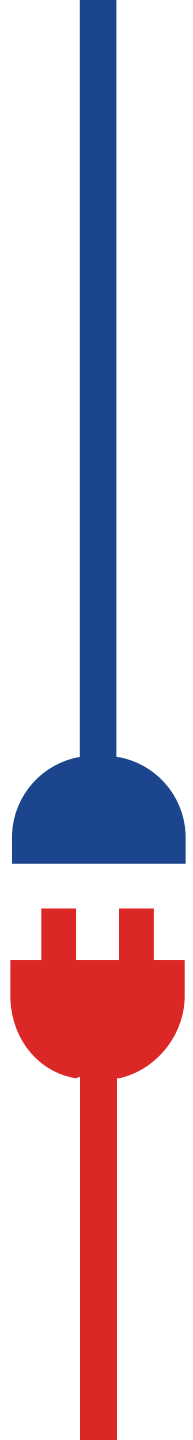


Electrification Backdrop





Live Better, Electrically – 1956



Policies & Decisions Leading to This Point

Primary Drivers = Health, Air Quality, Climate Change



1963	1968	1970	1976	1988	1990	2005	2006	2016	2018	2018
US clean Air Act Amended 1965/67 1970/77	C.A.R.B. Board Forms	Clean Air Act shifts Fed's role allowing states to limit	A.Q.M.D formed across the state	CA Clean Air Act becomes Law	Clean Air Act amended & admin by US EPA	CA EO S-3-05 sets GHG emission targets	AB 32 CA Global Warming Solutions Act	SB 32 40% below 1990 levels by 2030	Executive Order B-55-18 takes a step further... requires carbon neutrality by 2045	SB 1477 Technology & Equipment for Clean Heating (TECH) Initiative



Fast Forward – It’s Happening Again Building Electrification is Here to Stay!

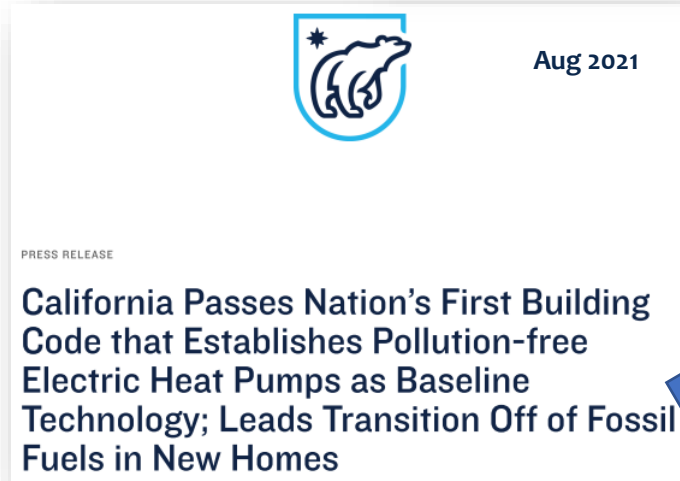


6MM Heat Pumps by 2030

THE HILL

San Francisco Bay Area to phase out natural gas furnaces and water heaters

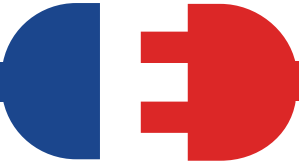
Air Quality Concerns Driving Policy



Code Prioritizing Heat Pumps



Plans Signaling Demise of Furnaces





Flames Out By 2030

6 Million

Heat Pumps Installed

California has a goal of 6 million heat pump installations in less than 7 years

No New Gas

Furnaces & Water Heaters

The California Air Resources Board has initiated plans to phase out new gas furnace & water heater installs. Starting even earlier in the Bay Area.

70+ Cities Have Adopted Building Codes to Phase Out Gas in New Buildings



- | | | |
|---------------------|-------------------------|-------------------------|
| 1. Carlsbad | 26. Campbell | 51. Santa Clara |
| 2. Berkeley | 27. San Mateo County | 52. Solana Beach |
| 3. Windsor | 28. Richmond | 53. Santa Clara County |
| 4. San Luis Obispo | 29. Hayward | 54. Contra Costa County |
| 5. San Mateo | 30. Santa Cruz | 55. Half Moon Bay |
| 6. Santa Monica | 31. Burlingame | 56. Belmont |
| 7. Menlo Park | 32. San Anselmo | 57. Hillsborough |
| 8. San Jose | 33. Piedmont | 58. Hercules |
| 9. Davis | 34. Redwood City | 59. Pasadena |
| 10. Marin County | 35. East Palo Alto | 60. Martinez |
| 11. Mountain View | 36. Los Altos | 61. San Bruno |
| 12. Morgan Hill | 37. Millbrae | 62. Livermore |
| 13. Palo Alto | 38. Sunnyvale | 63. Portola Valley |
| 14. Alameda | 39. Ojai | 64. Ventura County |
| 15. Milpitas | 40. Oakland | 65. Pleasanton |
| 16. Santa Rosa | 41. Albany | 66. San Leandro |
| 17. Pacifica | 42. San Carlos | 67. Glendale |
| 18. Mill Valley | 43. Daly City | 68. Dublin |
| 19. Saratoga | 44. Petaluma | 69. Corte Madera |
| 20. Brisbane | 45. South San Francisco | 70. Atherton |
| 21. Healdsburg | 46. Sacramento | 71. Riverside |
| 22. Los Gatos | 47. Santa Barbara | 72. San Rafael |
| 23. Cupertino | 48. Emeryville | 73. Los Angeles |
| 24. San Francisco | 49. Fairfax | 74. San Pablo |
| 25. Los Altos Hills | 50. Encinitas | 75. Agoura Hills |
| | | 76. Carpinteria |



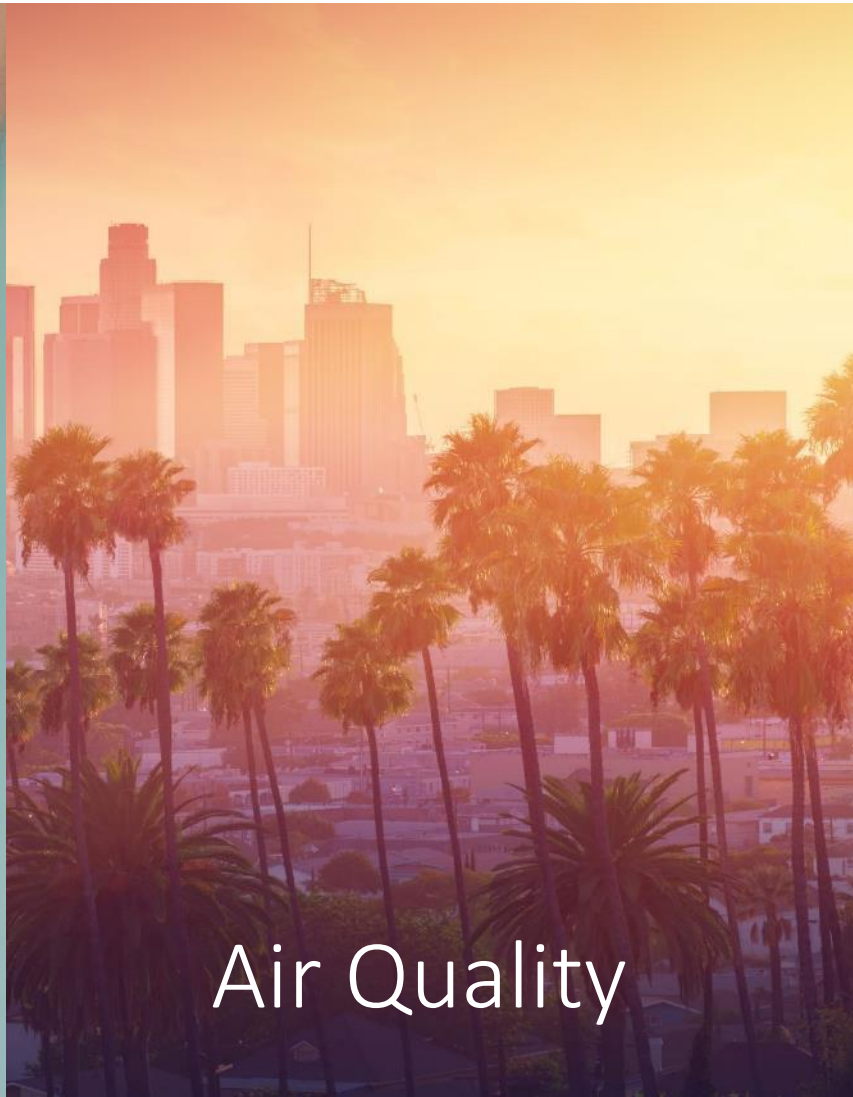
Image Source: Sierra Club



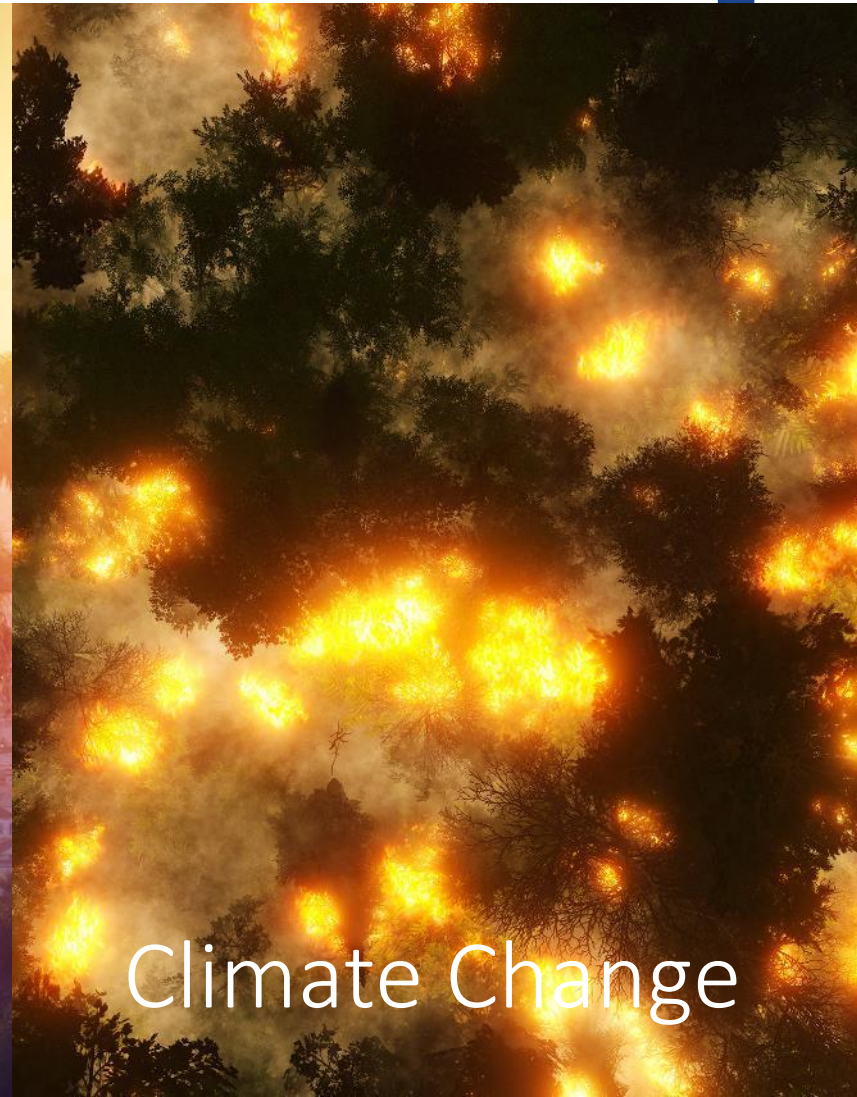
Why The All-Electric Resurgence



Health



Air Quality

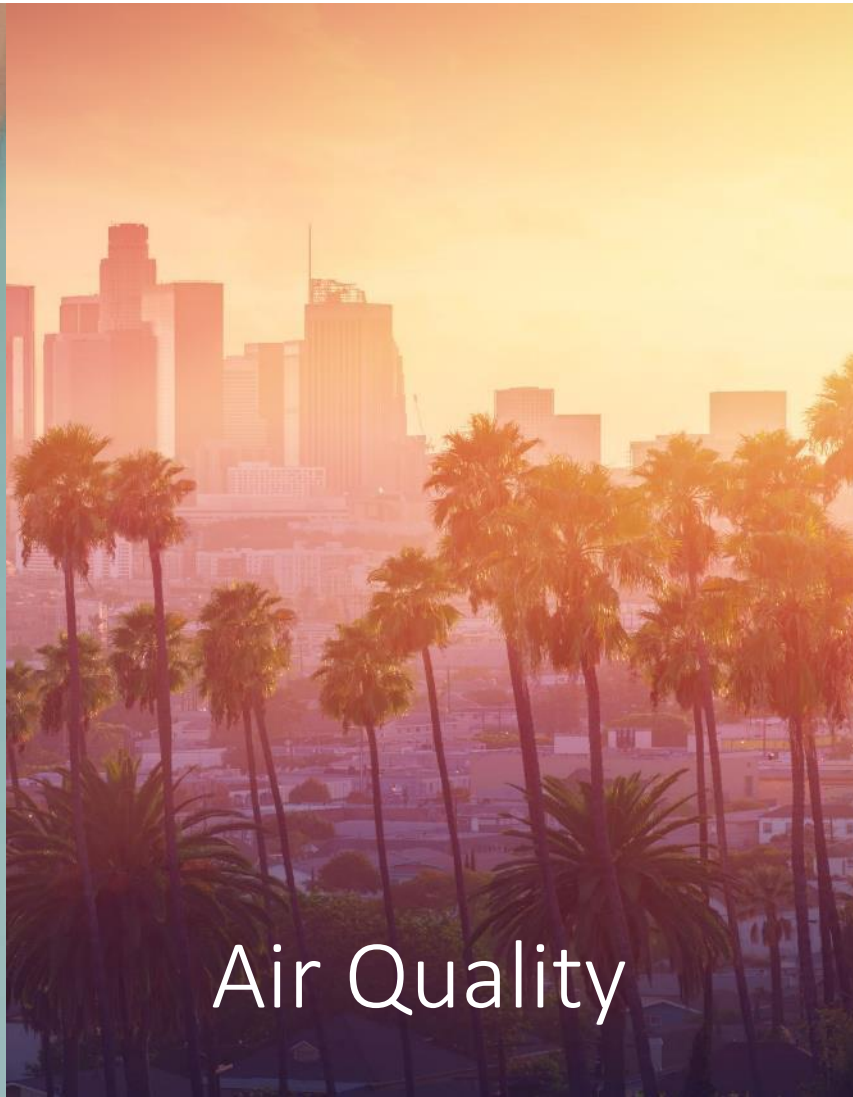


Climate Change

Climate Change Isn't #1 Policy Driver for Recently Announced Gas 'Bans'



Health



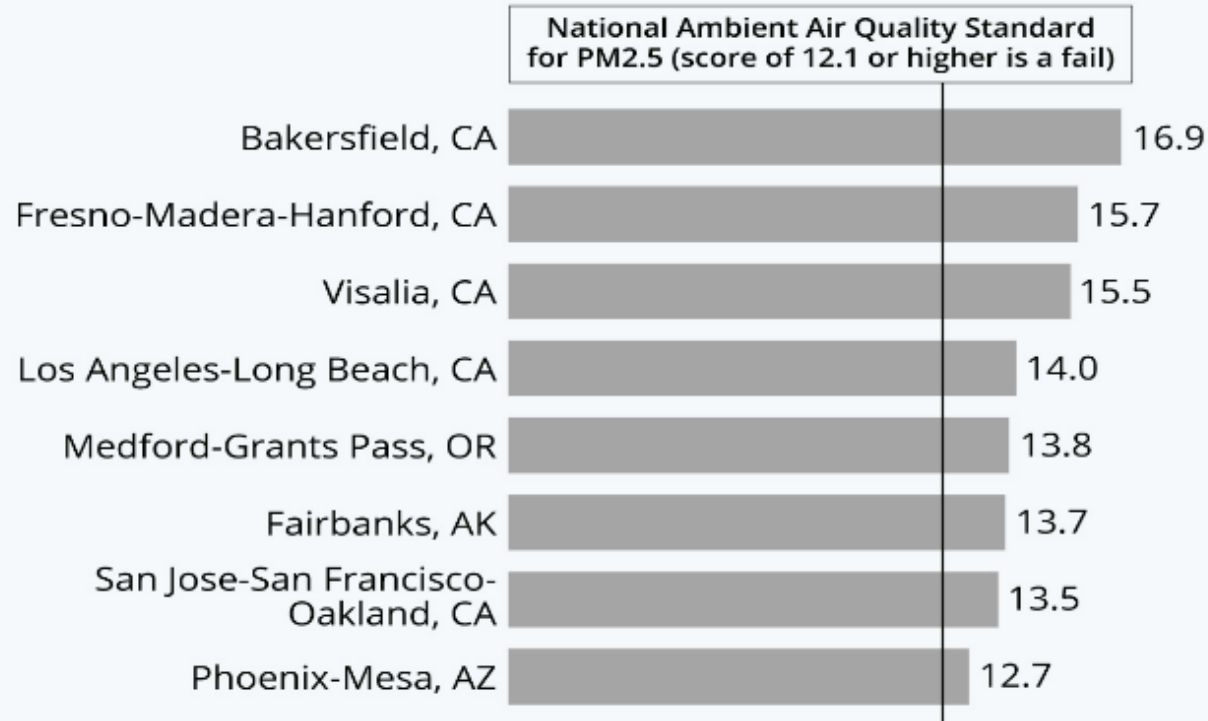
Air Quality



Climate Change

The Most Polluted Cities In America

Cities with the highest year-round levels of particle pollution in the U.S. (2017-2019)*



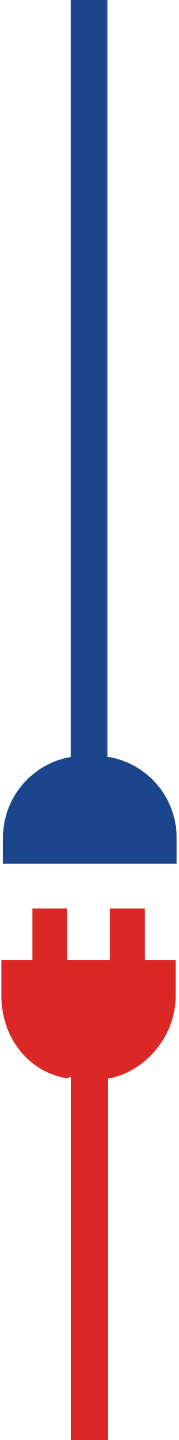
* Values based on ALA's design value - calculated concentration of a pollutant based on the National Ambient Air Quality standard for PM2.5.

Source: American Lung Association's State of the Air 2021



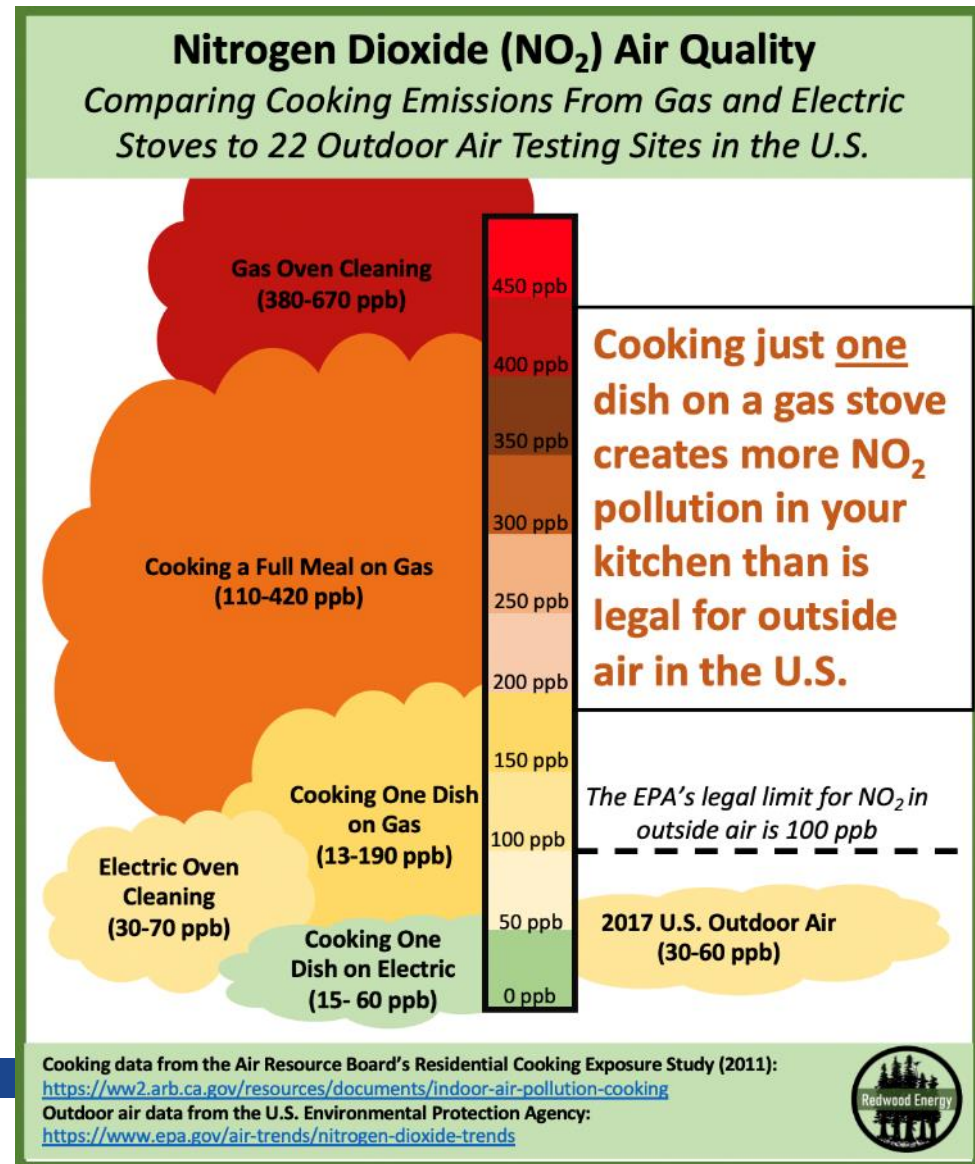
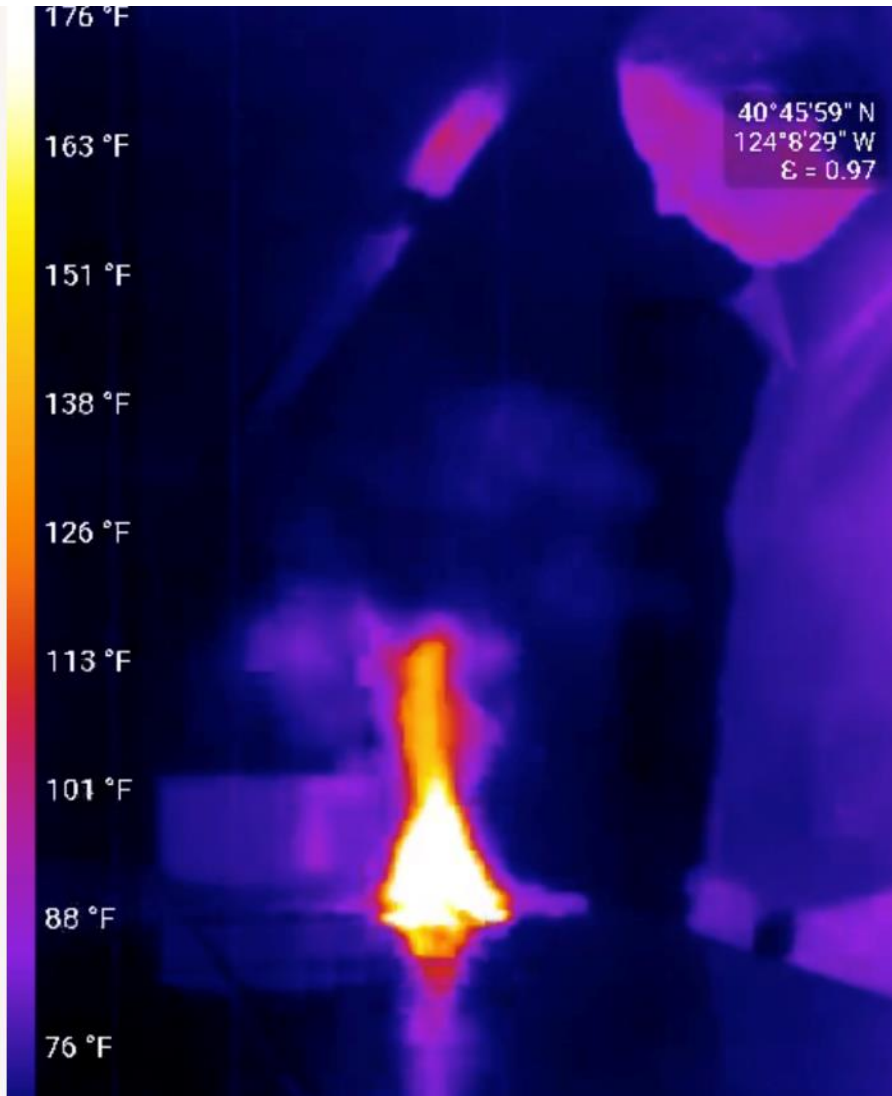
NO_x, CO, CO₂,
CH₄, N₂O, VOCs,
SO₂, PM

Local Pollution Source: Our Buildings



Clients Clinging to Gas Stoves?

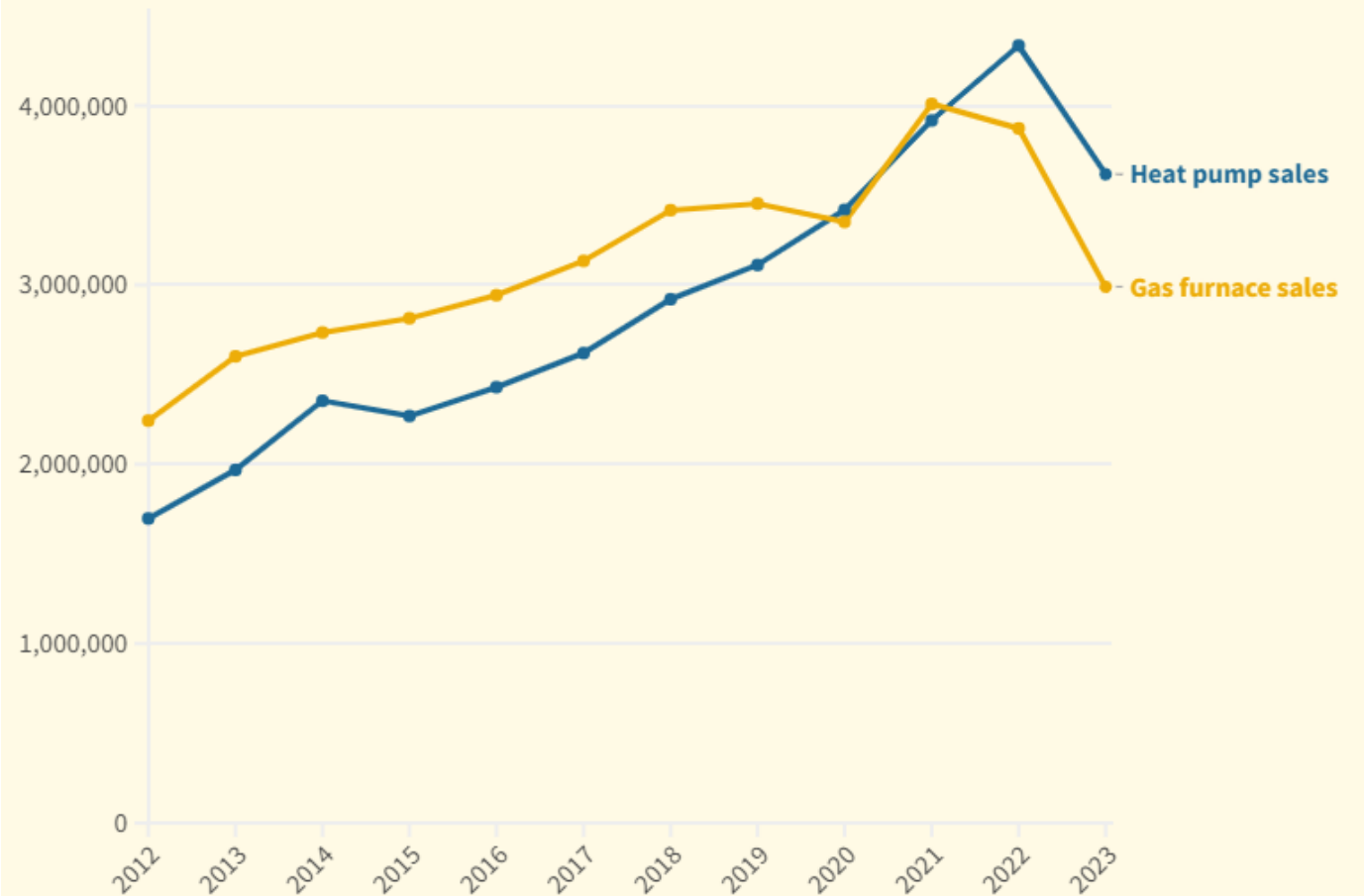
Just Remember, They're Like A Pack of Cigarettes



The Tide
~~is Turning~~
has turned

Heat pumps outsold gas furnaces again in 2023

Units shipped, per year, in the U.S.



Source: [Air-Conditioning, Heating, and Refrigeration Institute](#) • Units shipped are an approximation of sales.

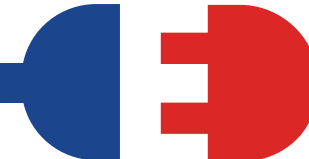
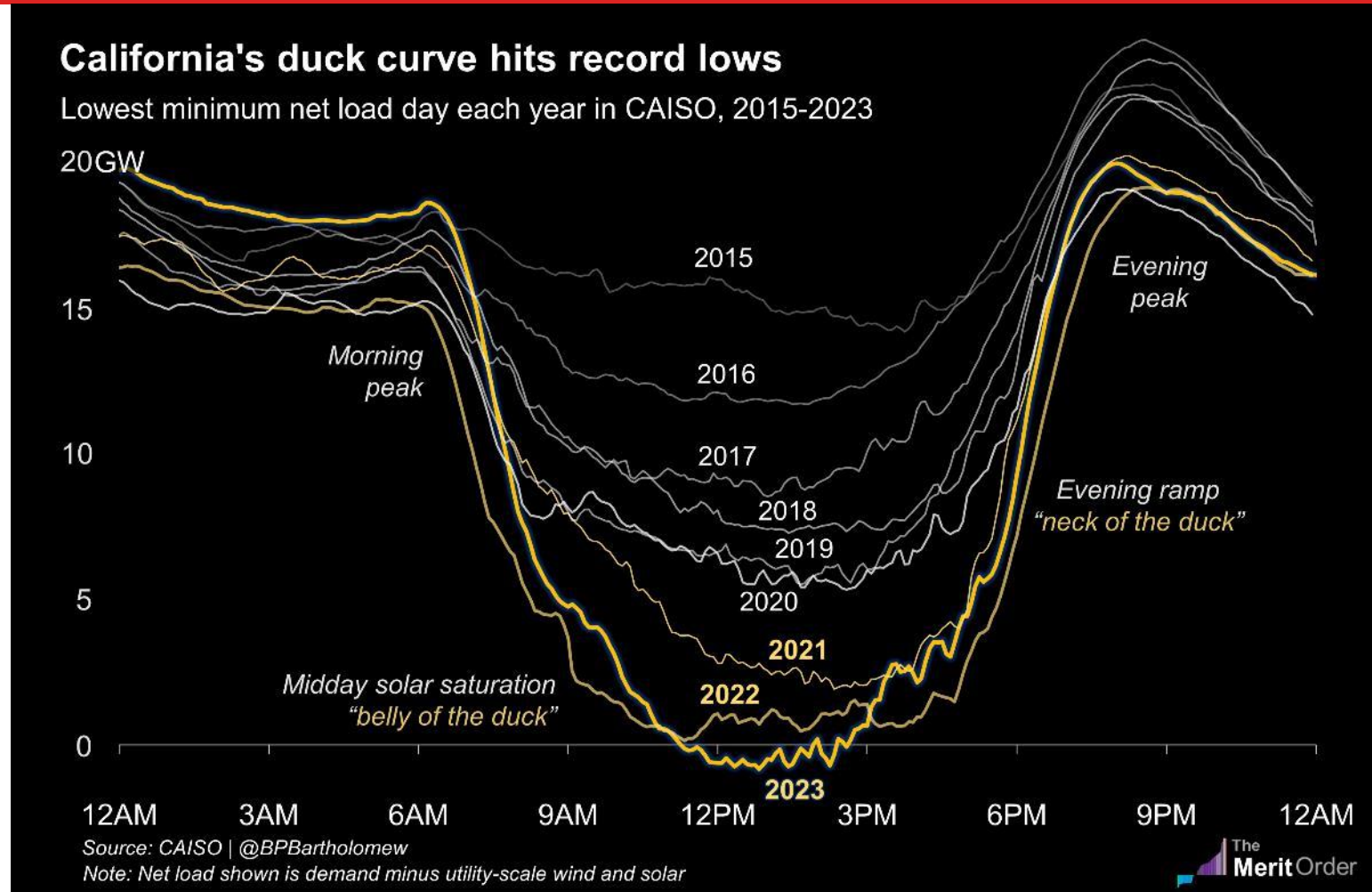
CANARY MEDIA



Gas is No Longer a Good Investment

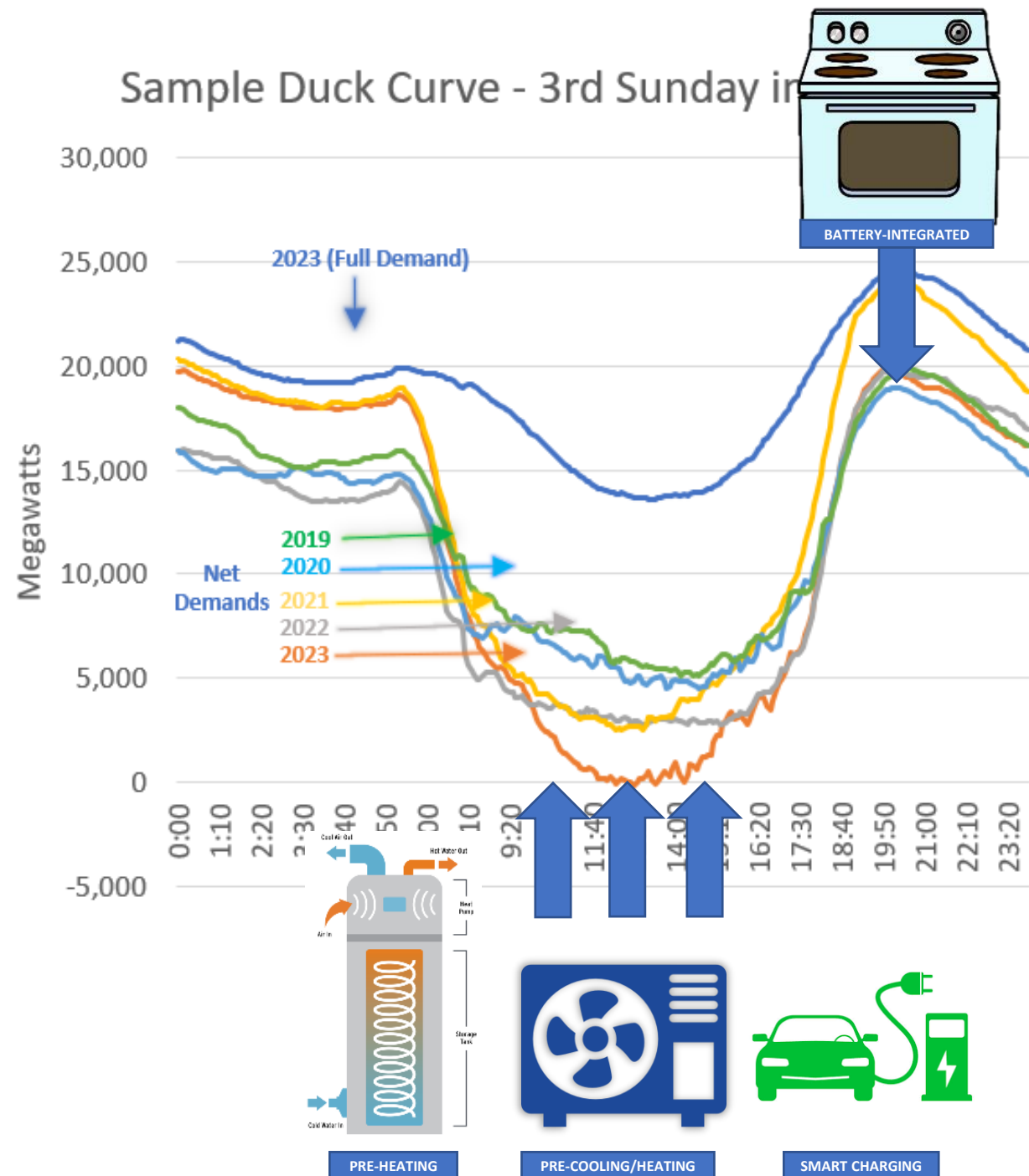
- ❖ Gas cost is going up
- ❖ Experts agree could quadruple in next decade
- ❖ Can't offset a gas bill with solar
- ❖ Remaining gas customers will share the cost of the pipeline maintenance
- ❖ Gas heating systems in homes will be a liability when selling
- ❖ EPA announced they will no longer label any gas appliances ENERGY STAR Most Efficient

2023 Duck Curve



The Duck Curve

- California's Clean Energy Challenge
- A big part of NEM 3.0 justification
- Opportunity for innovation
- Smart electrification can help with Virtual Power Plants
- Any new building or renovation should incorporate grid-friendly approaches





Mark Z. Jacobson

@mzjacobson · Follow



It has happened

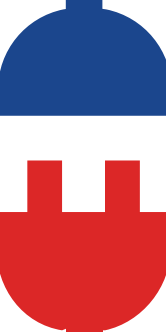
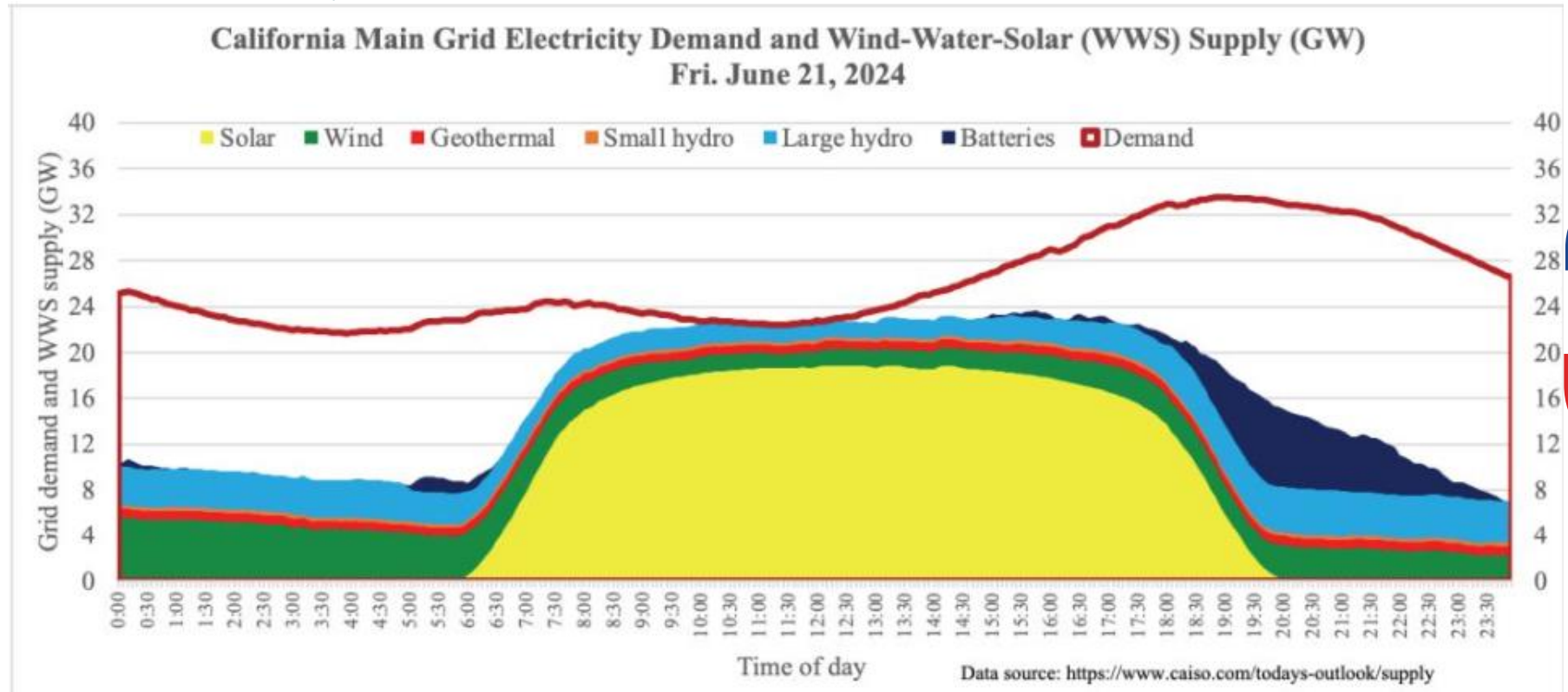
100 days of 100% #WindWaterSolar

Sun, July 28, California reached a milestone. The world's 5th-largest economy met 100% of @California_ISO demand with >100% WWS for the 100th day since March 7. July 27 was day 99 (for 4.9 h)

Strong summer winds helped

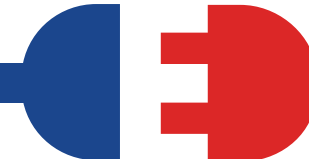
Wind, Water & Solar Is Starting To Work!

Clean Electricity + Electric Appliances = Success



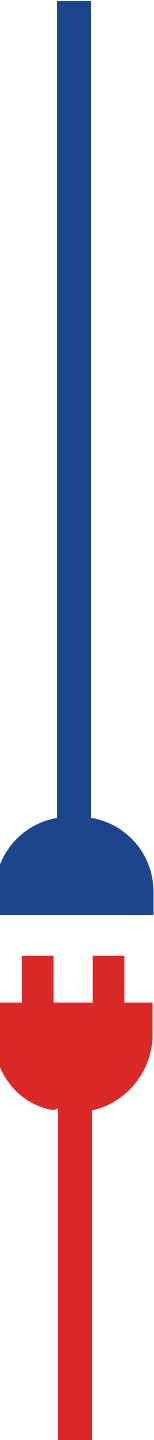
Our Favorite Benefits of Correctly Designed Electrification Upgrades (HVAC Focused)

- 1) Better Comfort
- 2) Quiet
- 3) Enviro. Friendly
- 4) Safer
- 5) Indoor Air Quality



Electrification for Architects & GCs

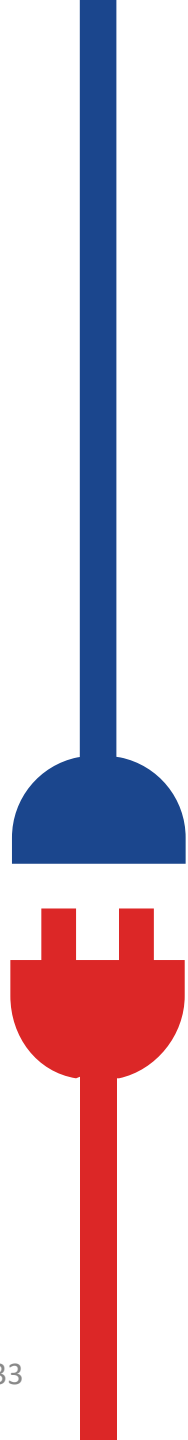
How Are We Doing w/ New Builds?



Are New Homes Comfortable?



New Home Comfort?





New 2-Story Home Comfort? With Upstairs/Downstairs Zoning.

Start Test: (Lower Floor Only Calling)

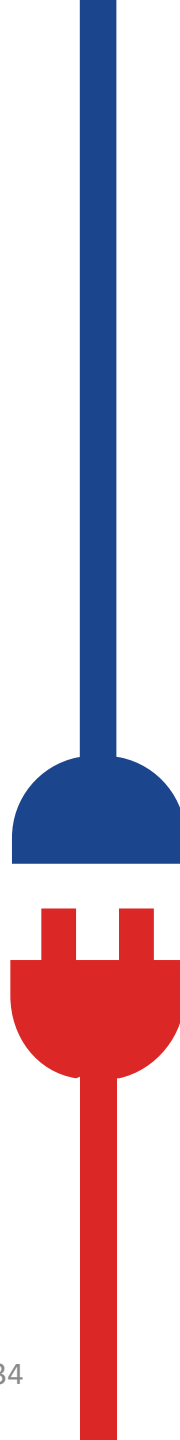
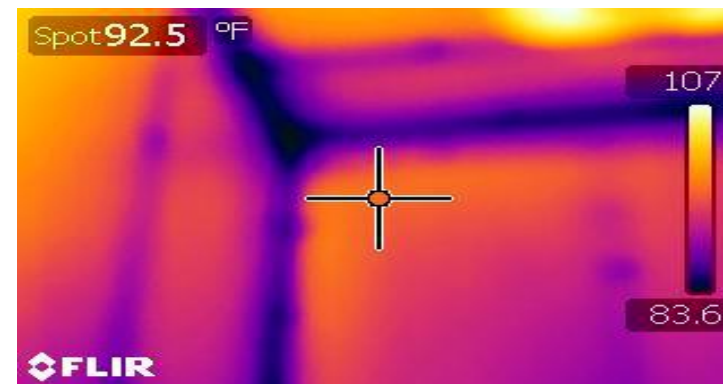
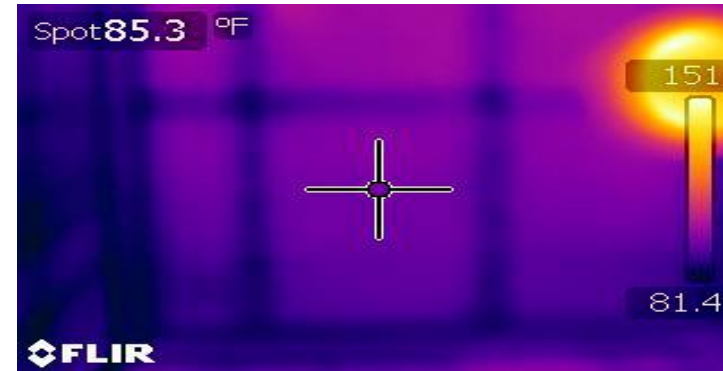
Lower Floor Thermostat	68°F
Upper Floor Thermostat	69°F
Upper Floor Ceiling	68.4°F

At 15 Minutes: (Lower Floor Only Calling)

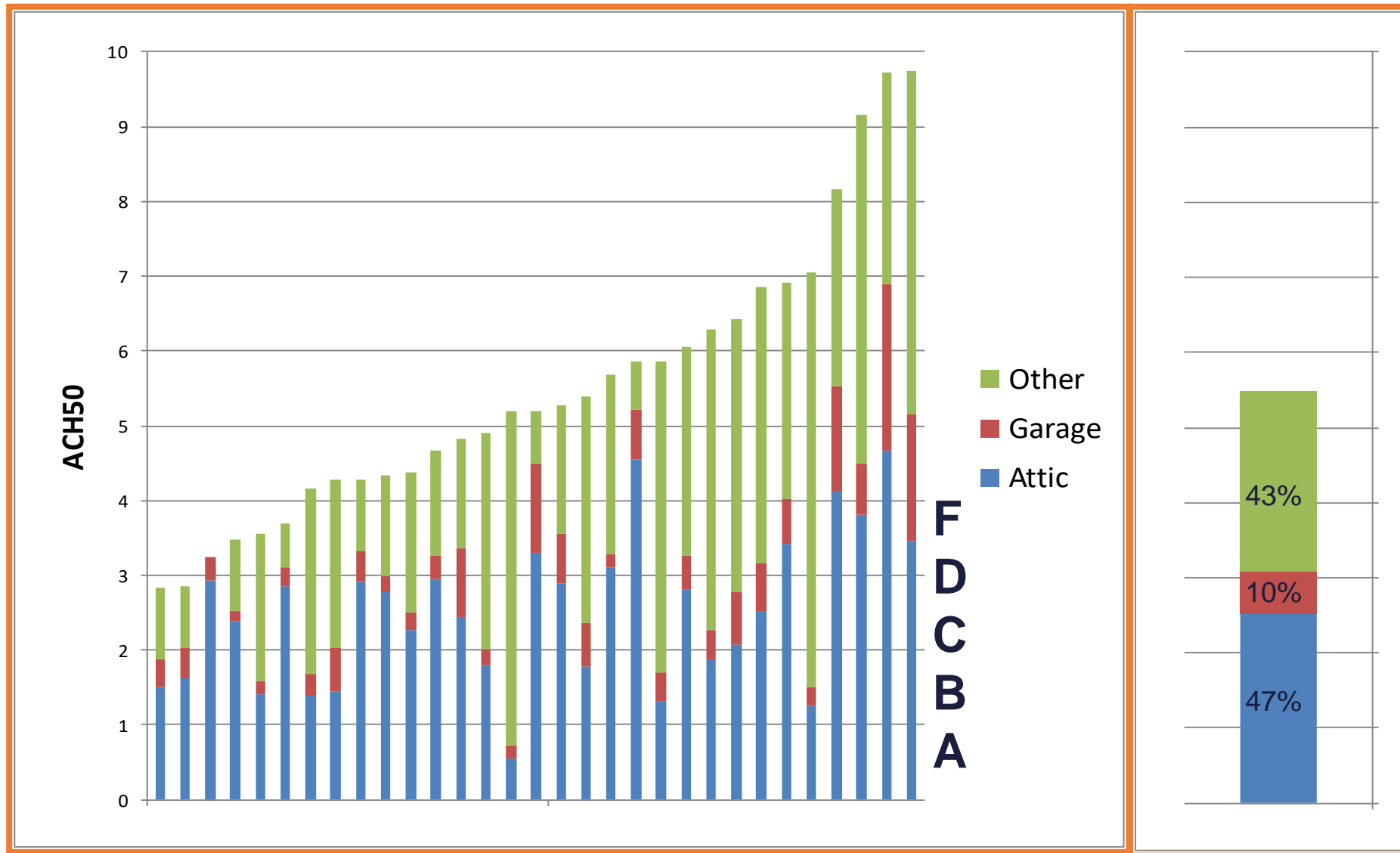
Lower Floor Thermostat	68°F
Upper Floor Thermostat	69°F
Upper Floor Ceiling	85.3°F

Test Ended at 53 Minutes:

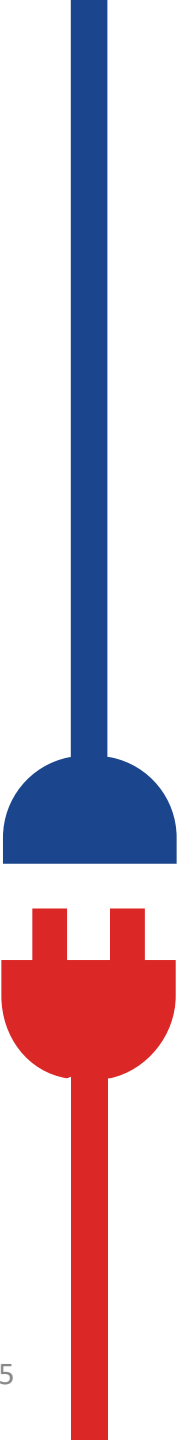
Lower Floor Thermostat	72°F
Upper Floor Closet	92.5°F



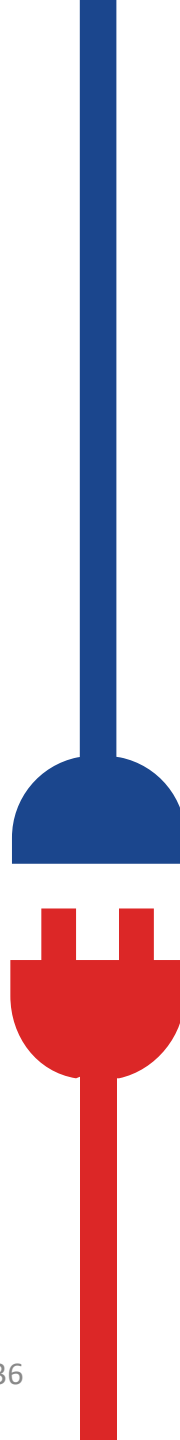
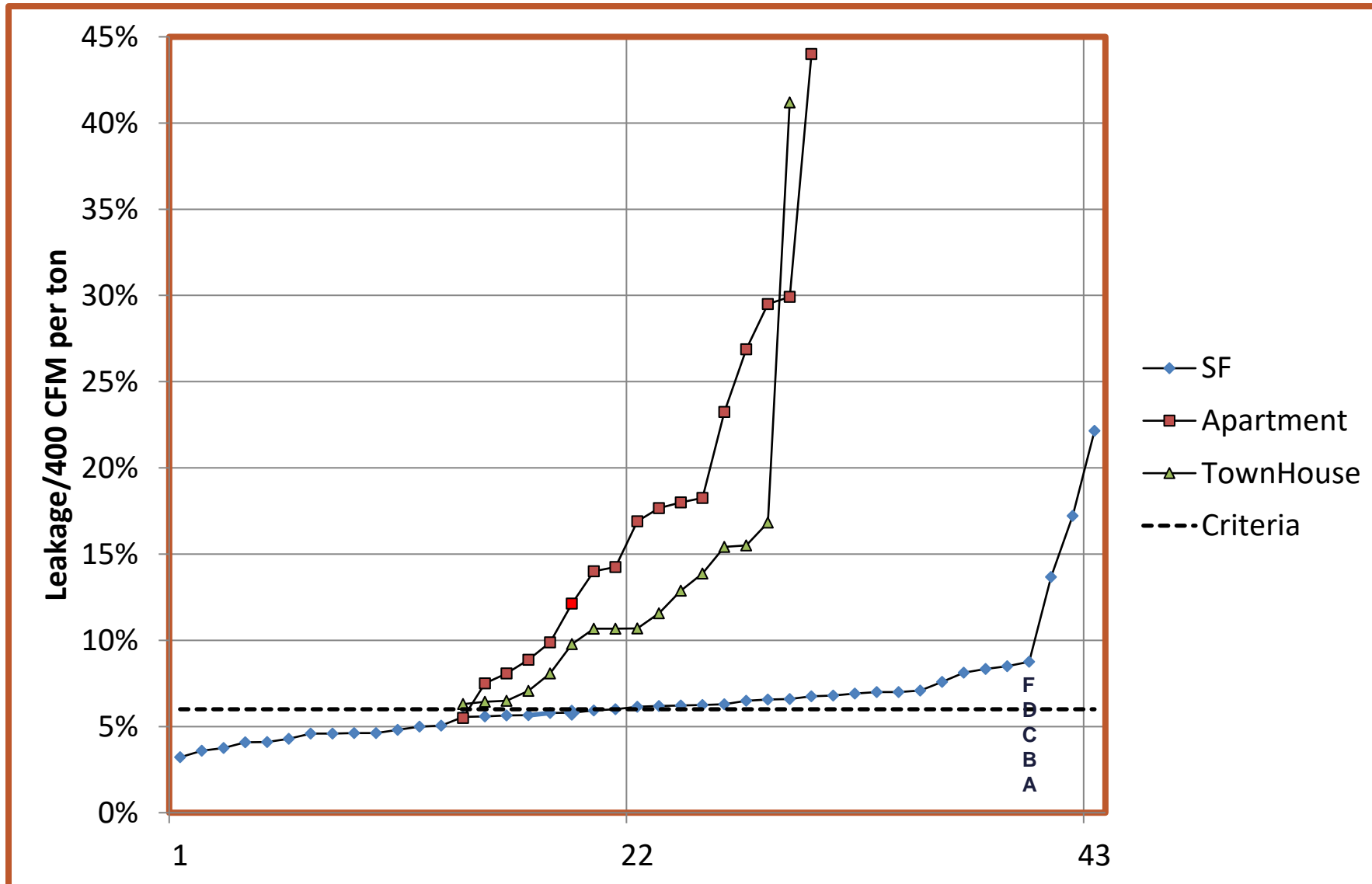
New Home Air Leakage Rates and Path



Source: California Energy Commission report 500-2012-062 and Rick Chitwood

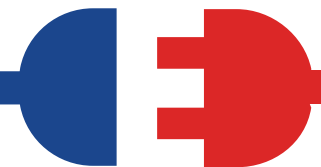


Total New Home Duct Leakage @ 25 Pa



The Frequency of Correct Room Air Flow in New Homes...

Room airflow (in CFM) that is correct	17%
Supply grill velocity that is correct	25%
Delivering the air to the unoccupied portion of the room	1%
Total Correct	0.04%



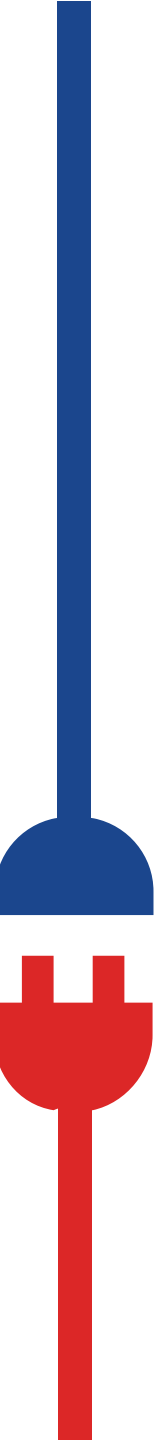


Your Duty To Your Clients

- You are the trusted advisor
- Is it advisable to recommend gas at this point?
- Not all electrification is created equal
- Poor upfront decisions are costly
- Let's break it down – PLANNING, DESIGN, EXECUTION

Electrification for Architects & GCs

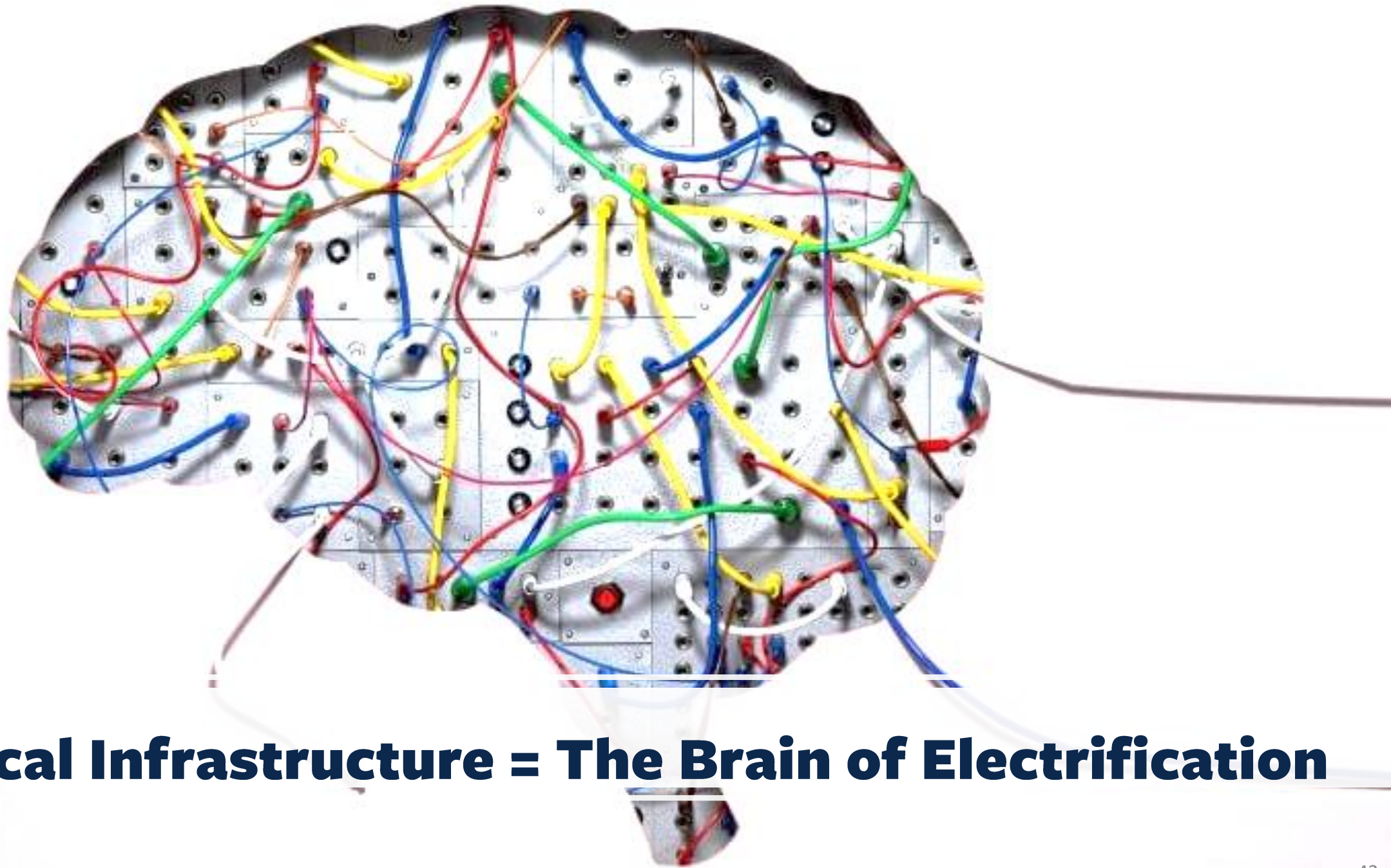
PHASE 1: PLANNING





What is Good Electrification?

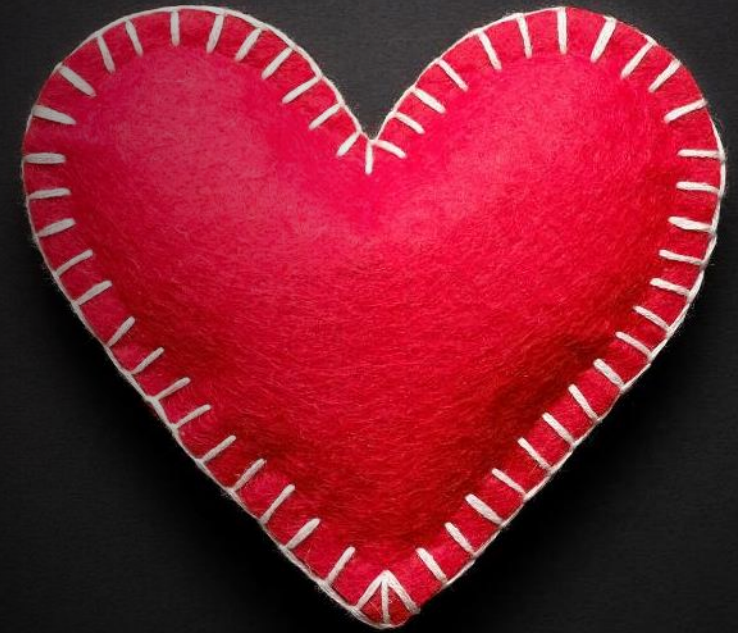
- ✦ Installing the most efficient solutions
- ✦ Utilizing existing infrastructure when possible
- ✦ Consider all electrification requirements from the start



Electrical Infrastructure = The Brain of Electrification



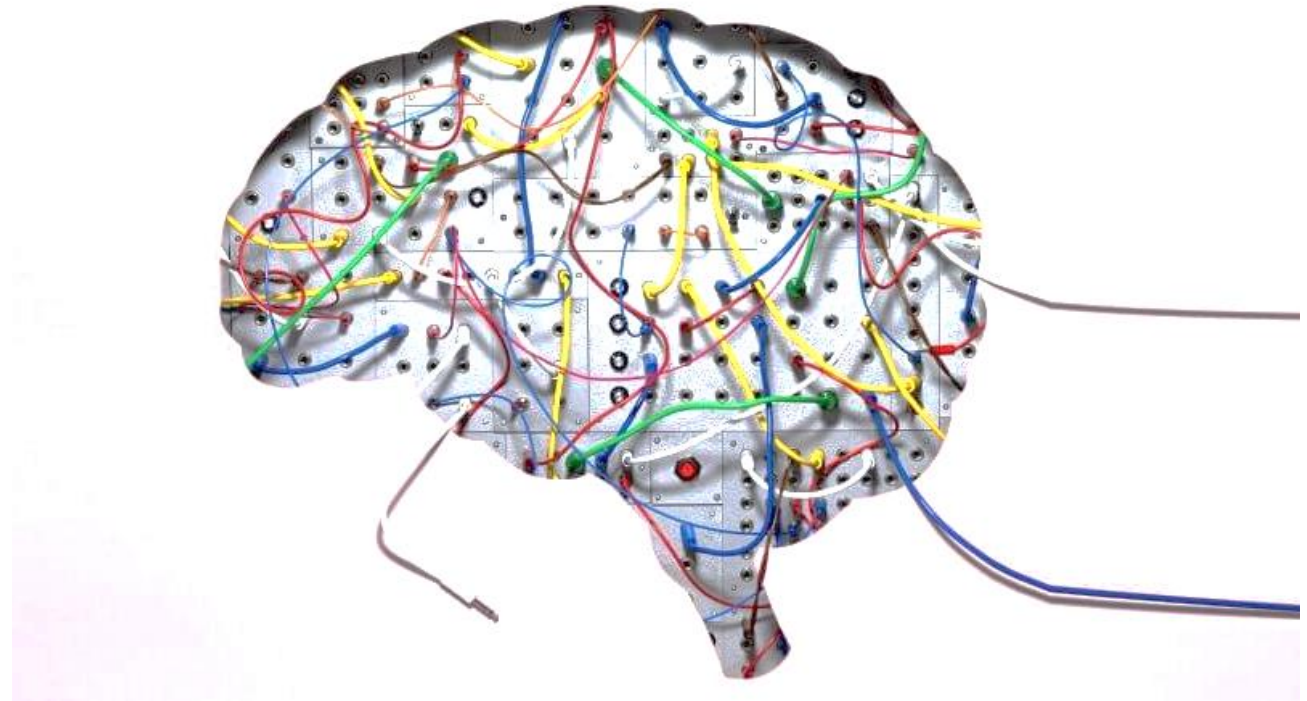
Heat Pumps are the Heart of Electrification



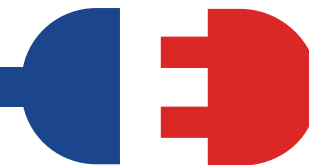
The Analogy, Tied Together



- ✦ Make sure you use the right heat pump for the right application

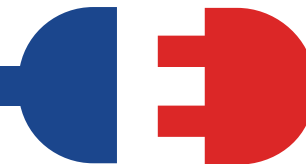
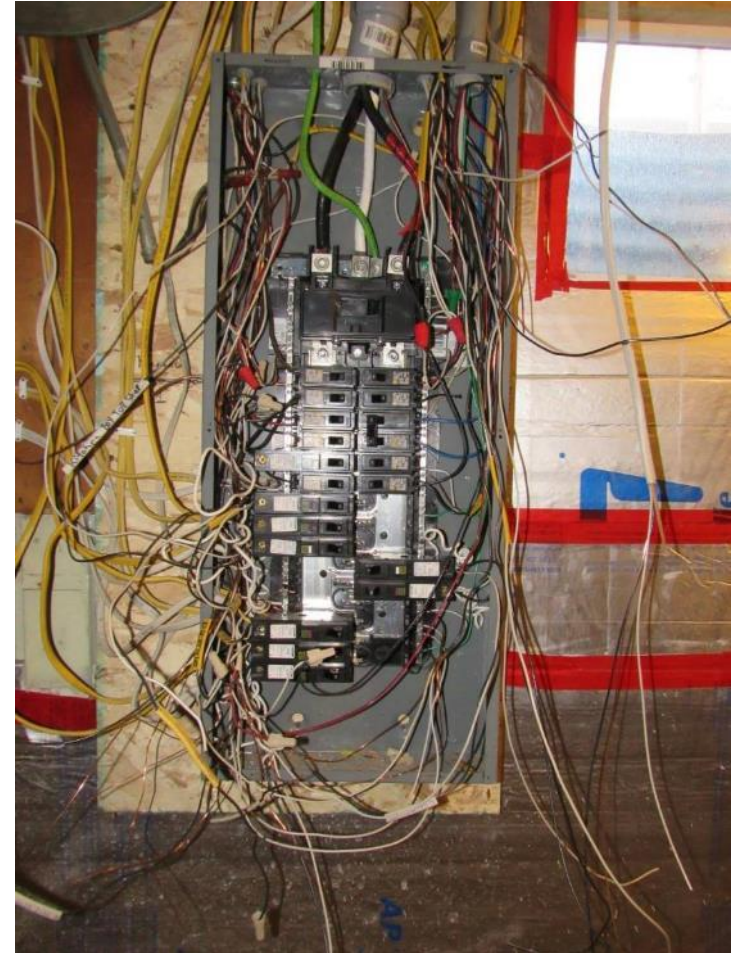


- ✦ Don't fill your brain (panel) with garbage



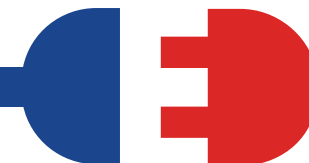
Panel Planning is Essential To a Successful Electrification Journey

- ⚡ **Make sure an electrical load calculation is done – it's not hard**
- ⚡ **Assume all homes will eventually have an EV charger**
- ⚡ **Talk to customer about electrification plan (which you'll help design) and determine panel needs upfront.**
 - ⚡ **DON'T LEAVE THEM WITH SURPRISE PANEL WORK DOWN THE ROAD!**
- ⚡ **If there are utility roadblocks, consider a smart panel**



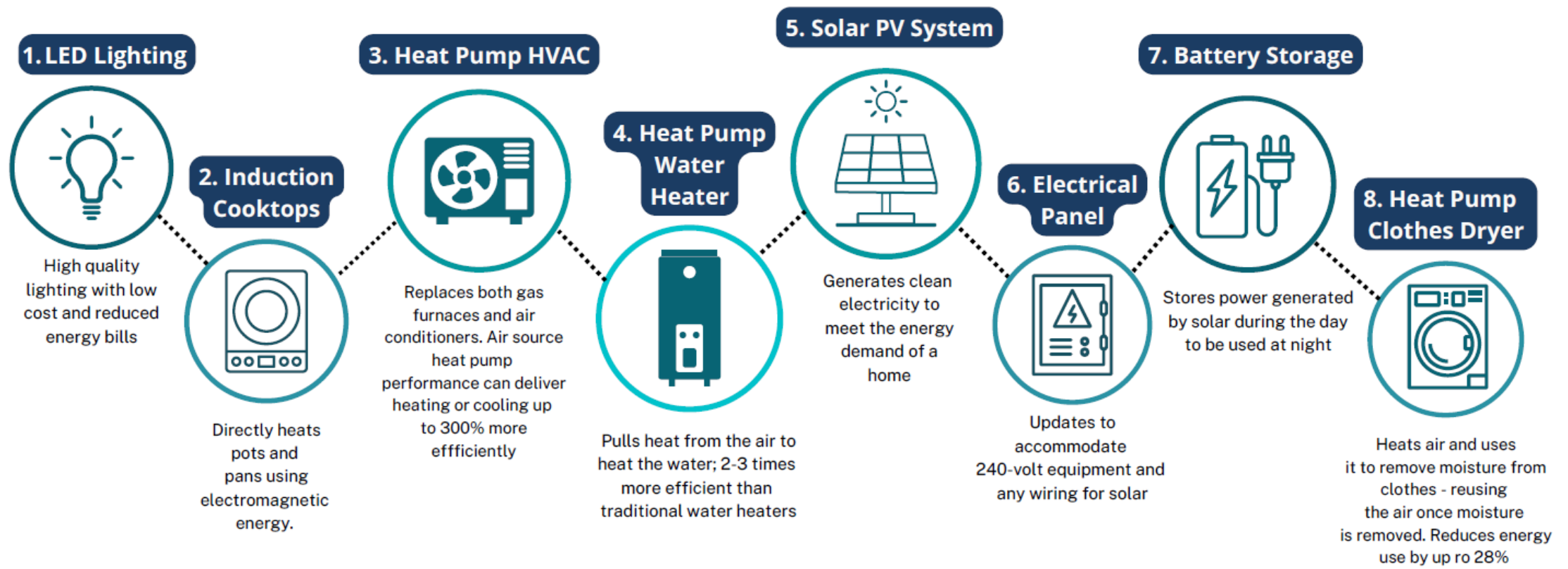
Example 1 – Richmond, CA

- 🔌 **Starting Point:** All gas
- 🔌 **1st Project:** Heat Pump + Panel
- 🔌 **2nd Project:** Solar/Battery
- 🔌 **3rd Project:** Heat Pump Water Heater
- 🔌 **The Issue:** multiple panel replacements, oversized HVAC leading to more expensive solar system
- 🔌 **Time Machine:** panel assessment with end in mind, downsized inverter to match home's needs, smaller solar array
 - 🔌 ~\$25,000 could have been avoided

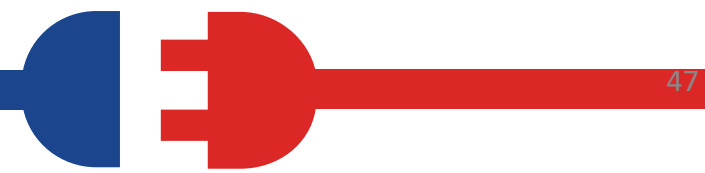


PLANNING: Chart a Course & Plan The Budget

Renovations are great times to electrify everything!



TIMELINE:	<u>Jan. 2025</u>	<u>Jan. 2025</u>	<u>Apr. 2025</u>	<u>Apr. 2025</u>	<u>Oct. 2025</u>	<u>Oct. 2025</u>	<u>Oct. 2025</u>	<u>Jan. 2026</u>
COST:	\$250	\$2,800	\$19,500	\$7,800	\$19,150	\$5,300	\$18,300	\$850



Common Bay Area Example

EXISTING



100A Service



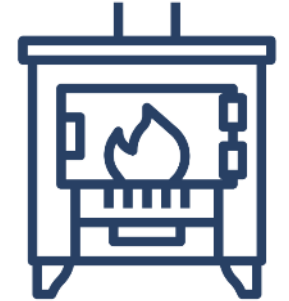
 Electric Dryer



 Gas Furnace



 Gas Water Heater




 Gas Range

PROPOSED




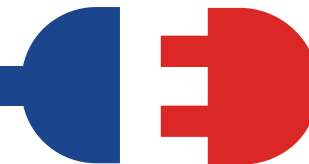
 Heat Pump



 HP Water Heater



 Induction Range



Staging Option 1

EXISTING



100A Service



⚡ Electric Dryer



🔥 Gas Furnace



🔥 Gas Water Heater



🔥 Gas Range

NEW

- **Keep panel** in place
- Specify **low-capacity HP**
- **Split** Dryer w/ HPWH
- **Pre-wire** for future range
- \$\$ Save up for solar, EV, & new panel



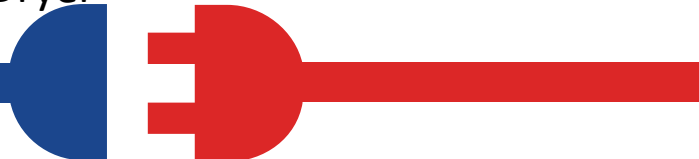
⚡ 20A Heat Pump



⚡ 30A HP Water Heater Split w/ Dryer



⚡ Pre-Wire Only



Staging Option 2

EXISTING



100A Service



⚡ Electric Dryer



🔥 Gas Furnace



🔥 Gas Water Heater



🔥 Gas Range

NEW

- Keep panel in place
- Low-capacity HP
- 120v HPWH
- Range split w/ EV charger



⚡ HP Dryer



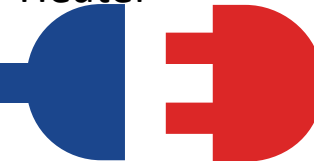
⚡ 20A Heat Pump



⚡ 120v HP Water Heater

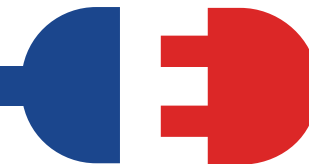


⚡ Induction Range



Discuss The Options!

- 🔌 Attend our products webinar!
- 🔌 Ducted vs ductless
- 🔌 Zoning with two systems
- 🔌 Ductless options for additions or trouble areas (discuss aesthetic)



Avoid Value Engineering HVAC

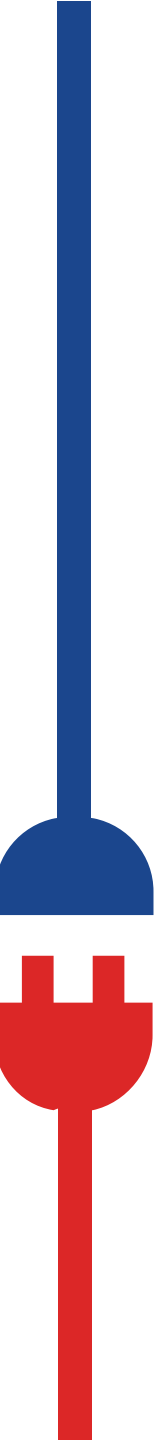
- ⚡ Include **HVAC design early on**
- ⚡ These are **long-term** decisions
- ⚡ Thermal comfort and health outcomes are **equally important** as aesthetic comfort
- ⚡ You may actually save by doing a **load calculation** to inform smaller equipment
- ⚡ Use any available **incentives** (e.g., \$3k CA Energy Smart Homes for new builds) to offset



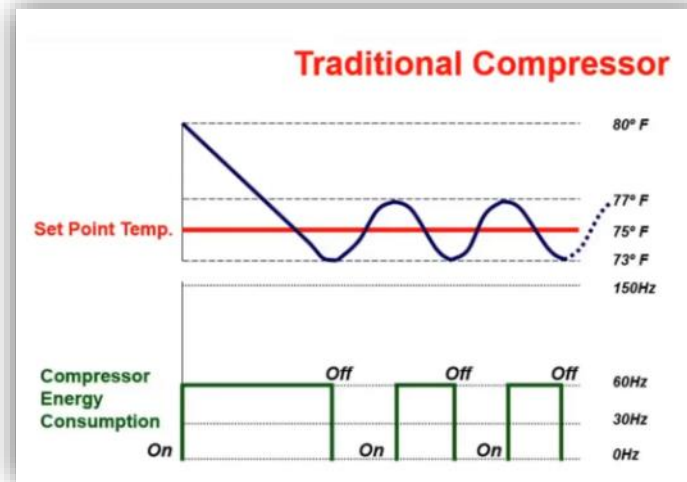
Source: Disher

Electrification for Architects & GCs

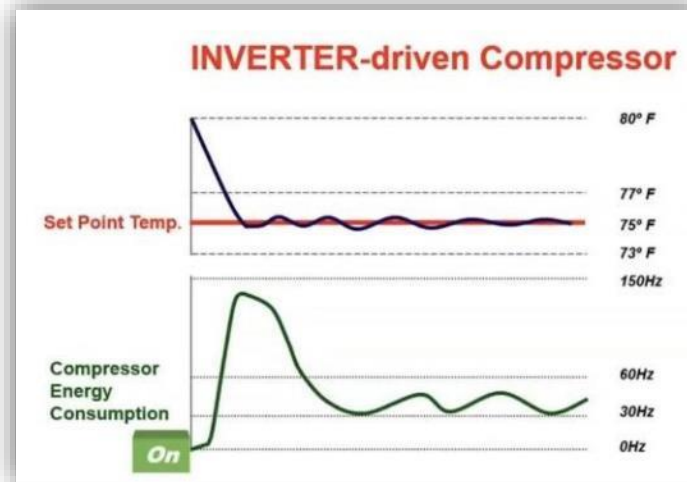
PHASE 2: DESIGN



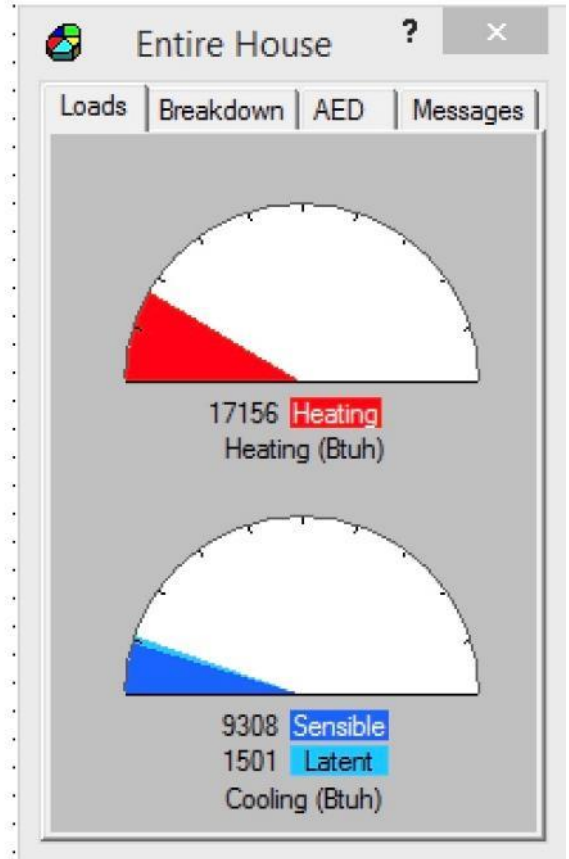
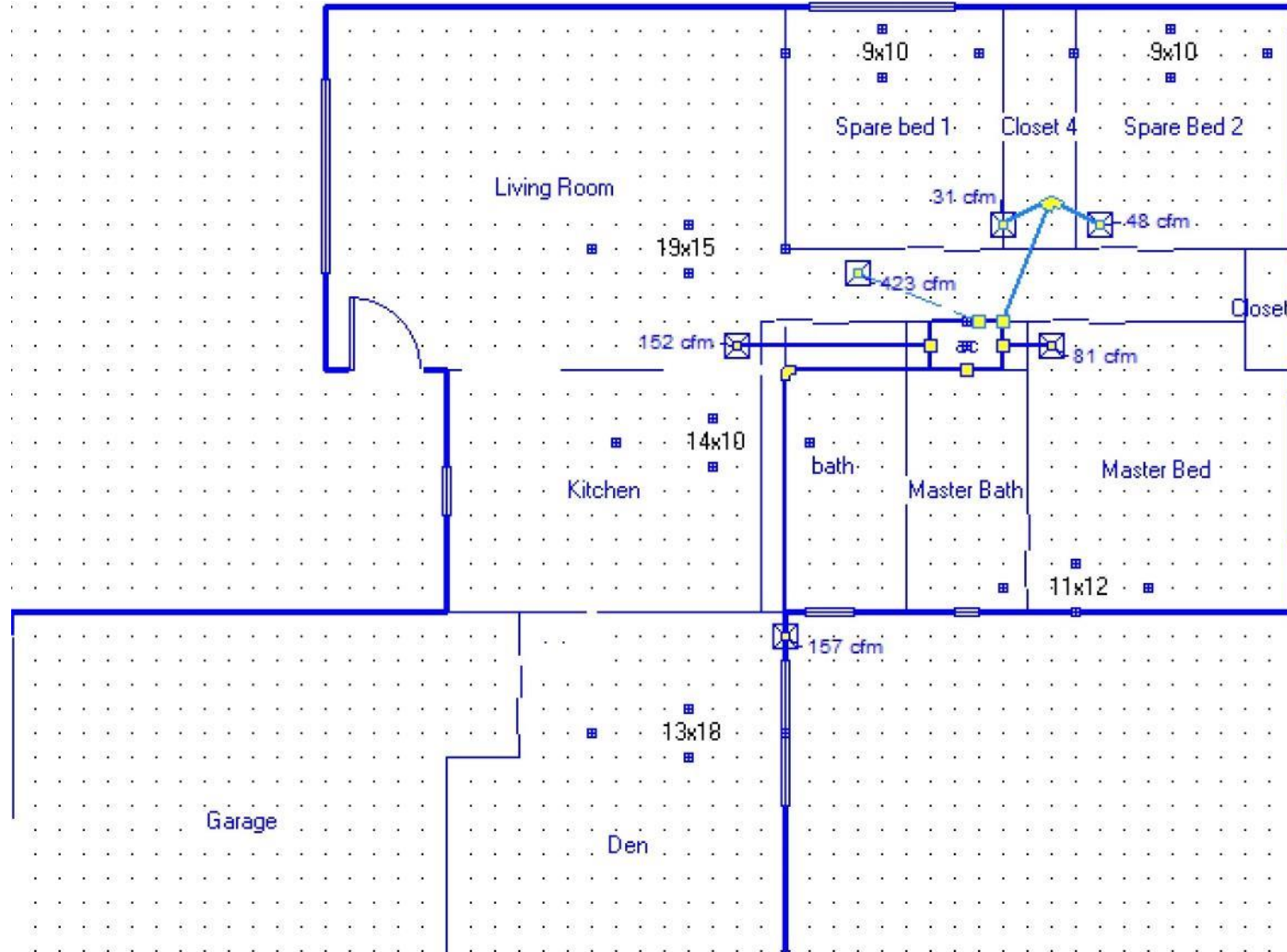
Pick Inverter Equipment!



VS

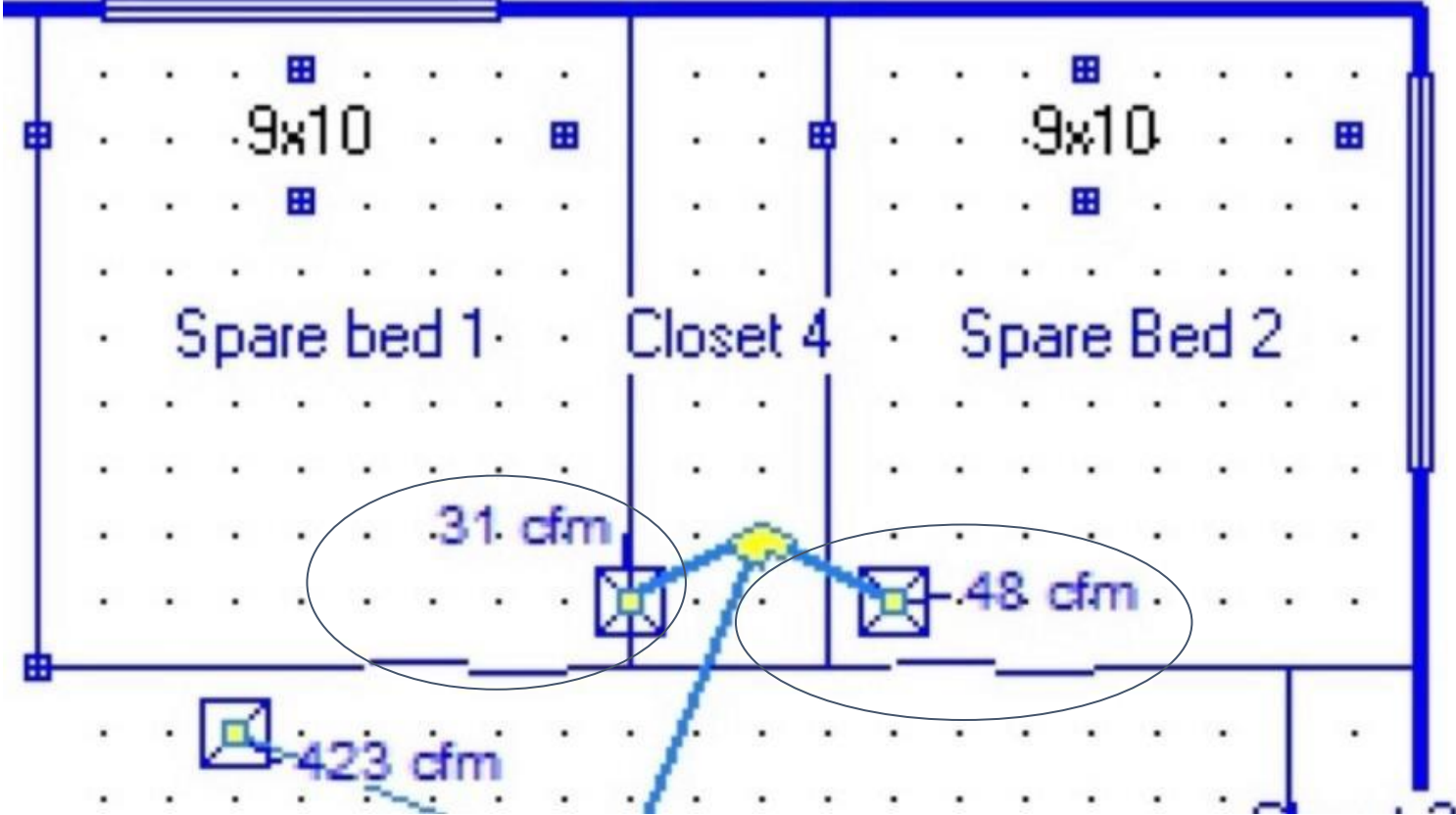


Perform HVAC Load Calculations – Manual J/D/S



Without a Calculation How Would you Know?

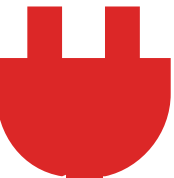
- 🔌 Same size rooms
- 🔌 Same size windows
- 🔌 Same side of the house
- 🔌 Different requirements



Equipment Requires Space



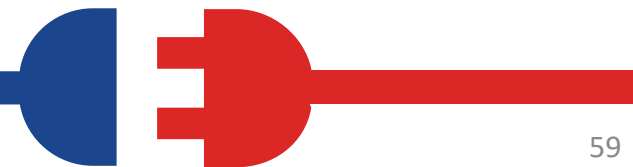
- ⚡ Heat pumps require an **outdoor & indoor** unit.
- ⚡ **Ductwork** needs space to run and it's not through a vaulted ceiling!
- ⚡ Must **follow codes**, which include minimum property line setbacks, distances from utility infrastructure, and other small details.
- ⚡ **Architects** – leave extra room in mechanical areas. Who knows what future devices your customer may want to add later.
- ⚡ Water heaters require space for **air exchange** or an easy path for ducting. HPWHs have larger diameters than gas units typically.



Address The Ductwork

Why Aren't Systems Efficient? DISTRIBUTION, NOT SEER!

- ❖ Very low air flow
- ❖ Duct leaks: 30% on old systems
- ❖ Duct conductive losses
- ❖ Size always matters (equipment size, duct size, grille size, etc.)
- ❖ Air delivery problems
 - ❖ Not enough air
 - ❖ Not enough air speed
 - ❖ Air blowing on occupants



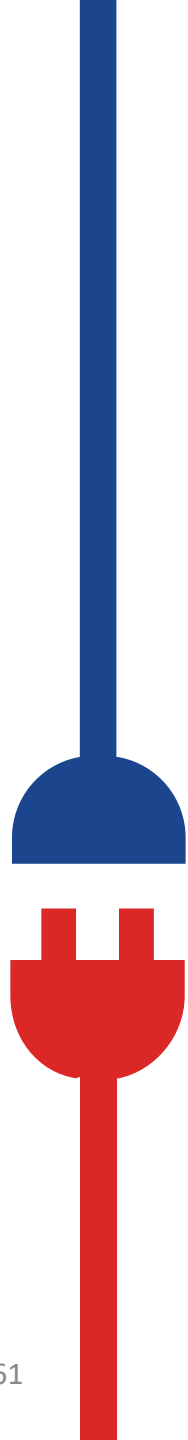


It's OK To Be Creative!

Locating the Return Air Filter Grille – For Comfort



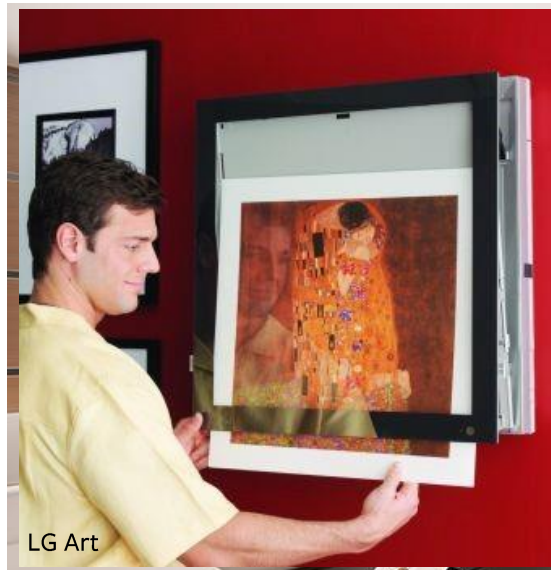
1. Return location has little impact on delivered comfort
2. Location has some impact on equipment efficiency
3. Return location has a large impact on static pressure and system air flow



There's No Way I'm Putting That On My Wall



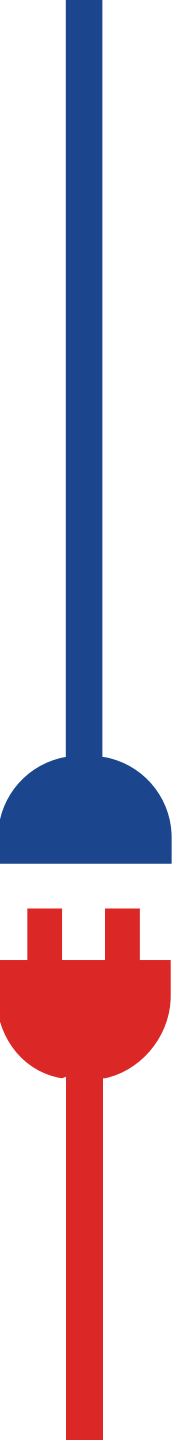
🔌 **Designed covers**



🔌 **Ceiling-mounted cassettes**

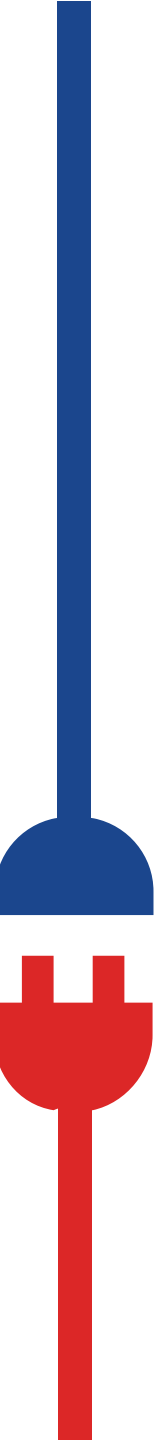



🔌 **Go ducted!**



Electrification for Architects & GCs

PHASE 3: IMPLEMENTATION



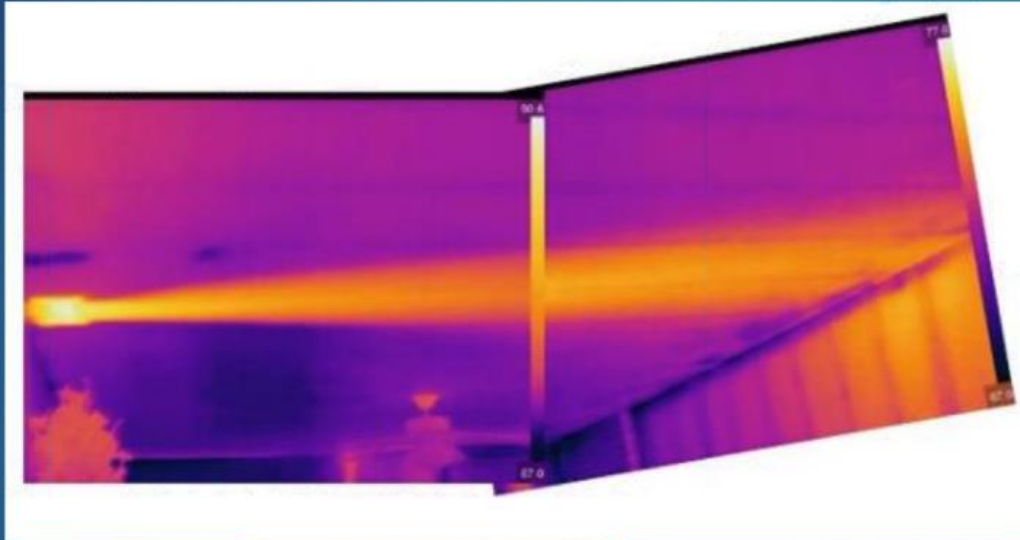


Ideas are cheap. Ideas are easy. Ideas are common. Everybody has ideas. Ideas are highly, highly overvalued. Execution is all that matters.

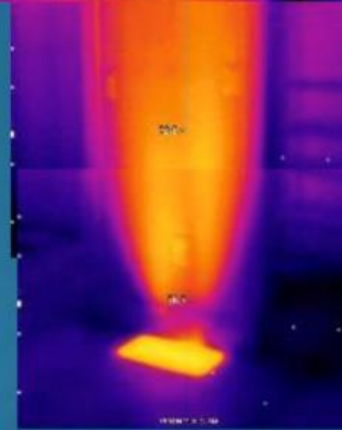
Casey Neistat

Install The Right Registers

Can the system
mix the room air?



22





Stamp Face Registers/Grilles

- ❌ No air stream mixture just adjacent hot spots
- ❌ Prevent air mixture stops venturi effect
- ❌ Causes hot and cold spots



Focus on Envelope (Example: Buried Ductwork)

Example: Calculating the Duct Gain

- ❖ Square footage of the home X 0.4
- ❖ T/D of the attic and the cold air in duct 125-55=70 degrees
- ❖ Determine the R-value of the ductwork

$$\text{Duct Gain} = \frac{\text{square feet} \times 0.4 \times \text{temp. difference}}{R - \text{value of ductwork}}$$

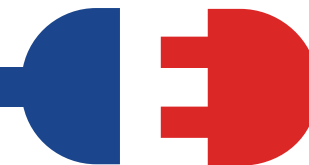
EXAMPLE → 1500 sq ft home, 125 degree attic, 55 degrees supply air, R3 insulation



With R-3 ducts: $\frac{1,500 \times 0.4 \times (125 - 55)}{3} = \frac{42,000}{3} = 14,000 \text{ BTU (1.2 TONS) lost to the hot attic}$

Buried ductwork (R-30): $\frac{1,500 \times 0.4 \times (125 - 55)}{30} = \frac{42,000}{30} = 1,400 \text{ BTU (0.1 TONS) lost to the hot attic}$

ALTERNATIVE
- Keep in
Building
Envelope!



Commissioning: Static Pressure & Airflow

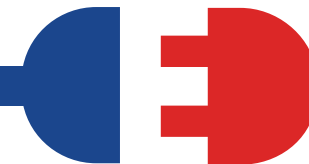
STATIC:

- ⚡ High static kills performance
- ⚡ More energy loss
- ⚡ Less delivered capacity
 - ⚡ Every bit counts on a heat pump



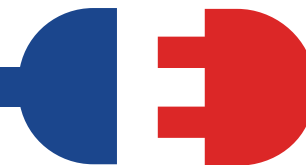
AIRFLOW:

- ⚡ Check with flow hood
- ⚡ Very important if ducts will not be accessible after renovation!



Optimize Duct System

- ❑ Keep Ducts as short as possible
- ❑ Use mechanical elbows at every 90-degree turn
- ❑ Install a damper in every duct
- ❑ Be mindful with your installation of the ducts; don't double back off a wye
- ❑ Ducts sit flat on the ceiling rafters with the damper handles facing up
- ❑ Measure to verify your ducts are not too short
- ❑ Use mastic on the inside of the duct and slide it over the metal connection
- ❑ Secure the duct with flexible plastic duct tape or Panduit strap
- ❑ Pull insulation from the duct to cover all metal
- ❑ Always have the *goal of zero leakage* in mind
- ❑ Tape all the seams on the air handlers to prevent air leakage



Takeaway: Well Designed Heat Pump Comfort is Unrivaled

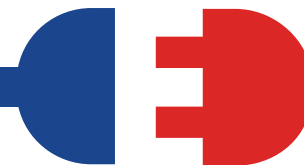
- ⚡ Code is already requiring electrification and pre-electrification.
- ⚡ However, code **does not** appear to be driving **comfortable outcomes**
- ⚡ For that, you need to work **installers** who:
 - ⚡ Understand heat pumps
 - ⚡ Do load calculations
 - ⚡ Incorporate system design best practices
- ⚡ ^ This company will not be the **lowest bid**. But will provide far **better outcomes**.



Questions? Stay in Touch!



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Thank you!

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