TRI-COUNTY
REGIONAL ENERGY NETWORK
SAN LUIS OBISPO • SANTA BARBARA • VENTURA

Higher-Performance Residential Remodels

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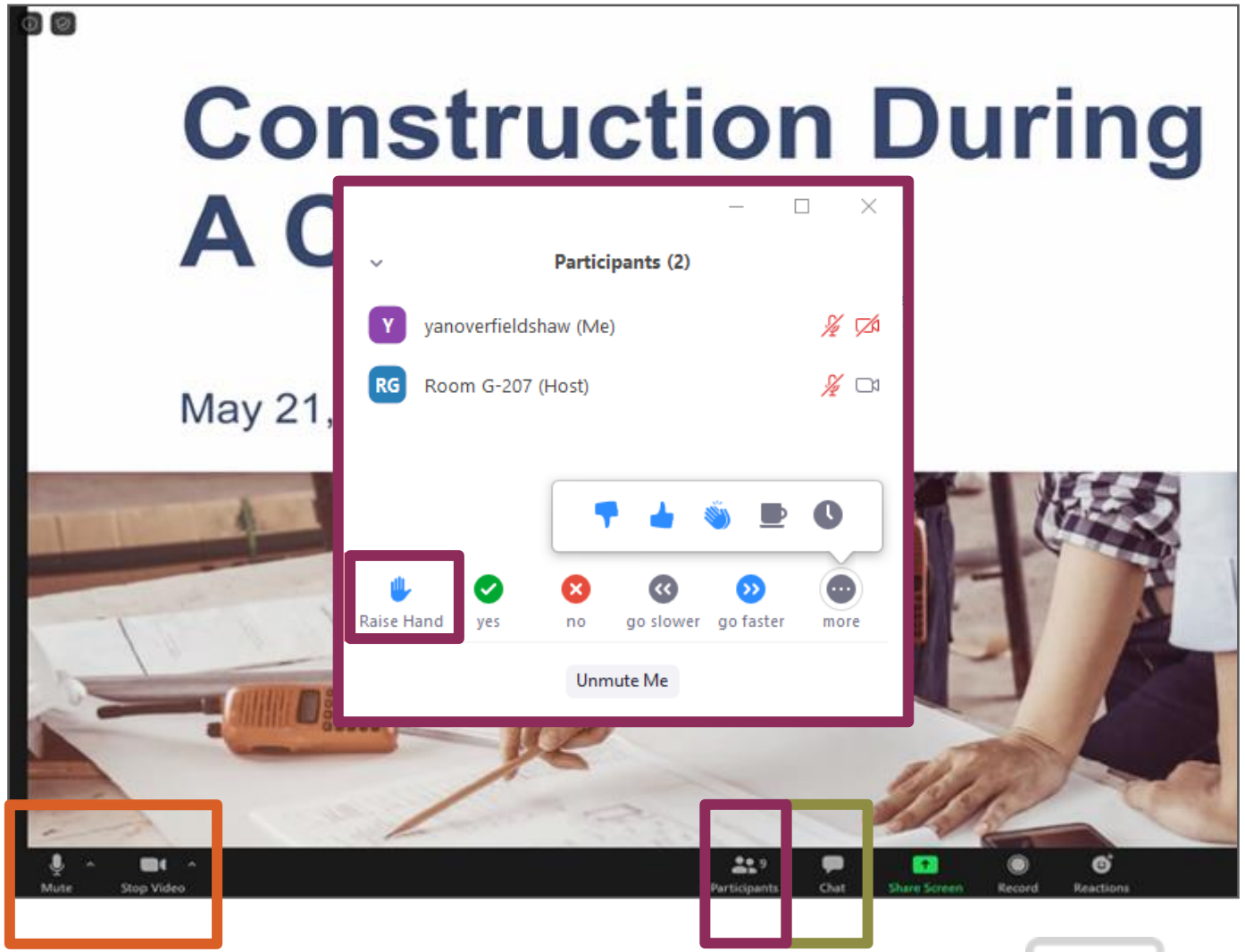
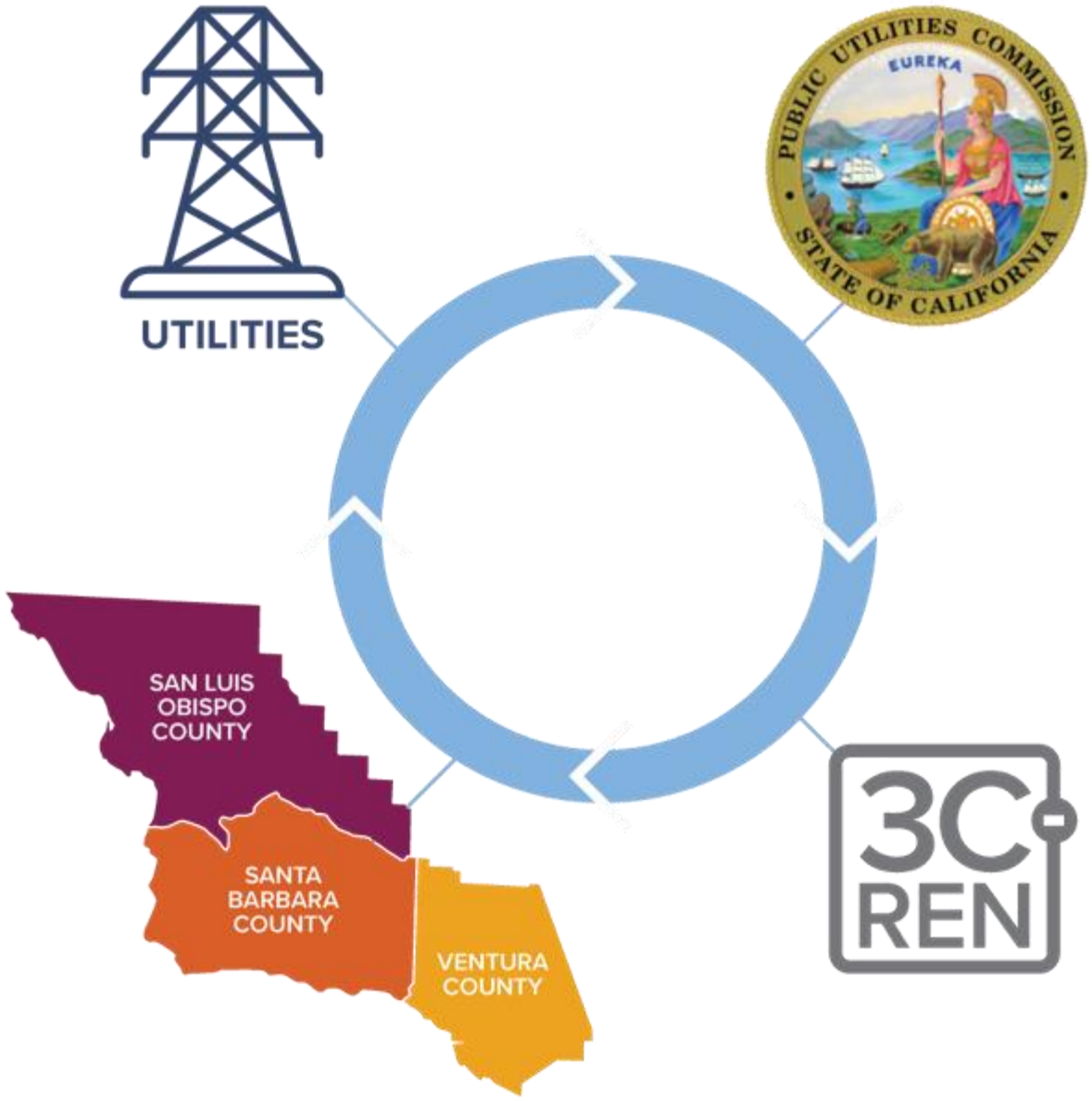
Cairn Collaborative Design-Build

April 24, 2025

Zoom Orientation

- Add an **introduction** in the chat.
  Be sure **full name** is displayed.
- Did you call in? Please **share** first and last name with us.
- Please **mute** upon joining
- Use the "**Chat**“ to share questions or comments
- Under "**Participant**" select "**Raise Hand**" to share a question or comment verbally
- Session may be **recorded** and posted to 3C-REN's on-demand page
- Slides/recording are **shared** after most events





Tri-County Regional Energy Network

3C-REN is a collaboration between the tri-counties

Our programs reduce energy use for a more sustainable, equitable and economically vibrant Central Coast

Our free services are funded via the CPUC, bringing ratepayer dollars back to the region

Our Services

Incentives

HOME ENERGY SAVINGS

3c-ren.org/for-residents
3c-ren.org/multifamily

COMMERCIAL ENERGY SAVINGS

3c-ren.org/commercial

Contractors can enroll at
3c-ren.org/contractors

Training

BUILDING PERFORMANCE TRAINING

3c-ren.org/events
3c-ren.org/building

ENERGY CODE CONNECT

3c-ren.org/code

View past trainings at
3c-ren.org/on-demand

Technical Assistance

AGRICULTURE ENERGY SOLUTIONS

3c-ren.org/agriculture

ENERGY ASSURANCE SERVICES

3c-ren.org/assurance

3C REN

3C-REN Achievements

4,000+

Individuals Attended Training

1,374

Energy-Saving Projects Completed

334

Title 24/CalGreen Questions Answered

$155M

Secured for investment in the tri-county region through 2028

Data from 2019-2023 for three programs

Agenda

1. Better Performance and Opportunities
2. Building Evaluations and Occupant Comfort
3. Heating/Cooling and Ventilation Equipment
4. Hot Water Heating and Appliances
5. Windows, Walls, Attics and Floors
6. Solar PV and Batteries

Today's Learning Objectives

Working through specific examples, we'll help project teams identify strategies that have the highest impact for improving energy efficiency, comfort and indoor healthy environments in renovations and additions.

- Learn how existing energy performance and indoor air quality is evaluated
- Review the benefits and challenges of moving toward all-electric equipment and appliances in a remodel
- Identify best practices and highest impact upgrades for retrofits
- Compare strategies for phasing-in improvements and where to start.

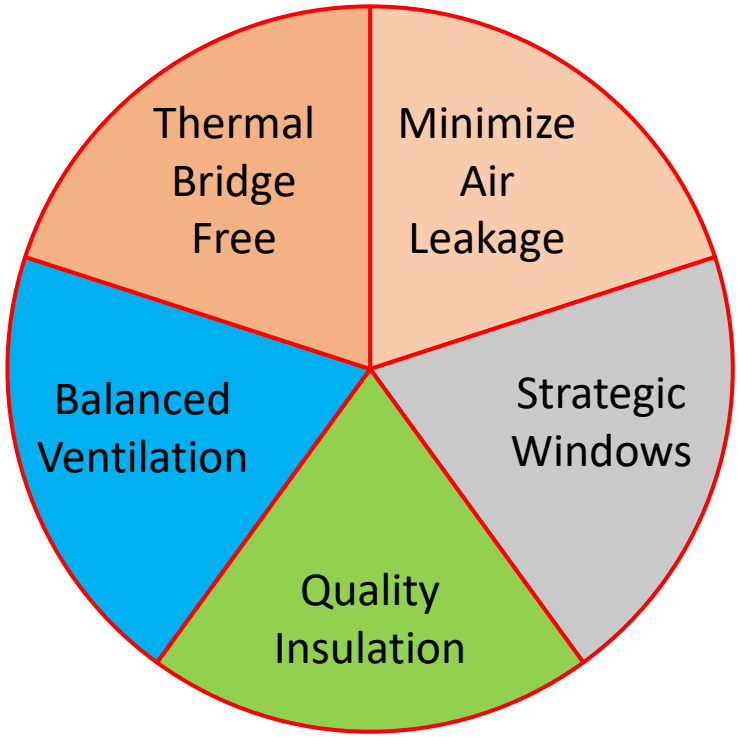
Learning Units:

- 1.5 AIA HSW LU approved for this course

Higher Performance and Opportunities

Ideal New Construction vs Reality of Remodels

1. Quality Envelope Assemblies:
   i. High Quality Insulation
   ii. Thermal Bridging Eliminated
   iii. Air Leakage Minimized
2. Strategically Placed Quality Windows
3. Balanced Ventilation (IAQ) System
4. Energy Efficient HVAC, DHW and Appliances
5. Solar PV and Battery Storage



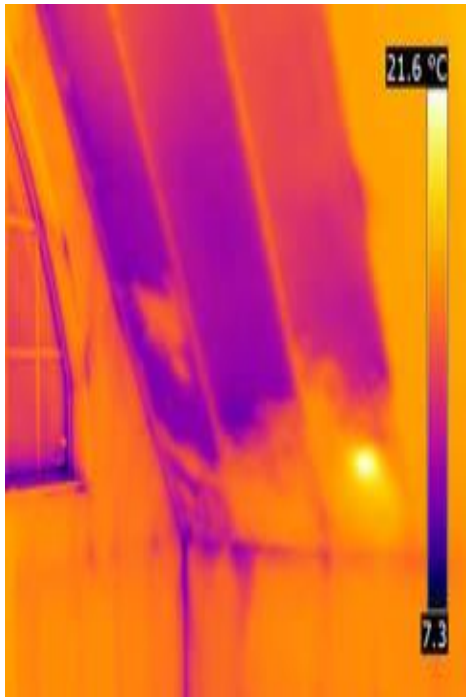
…but, what about remodels/alterations/additions?

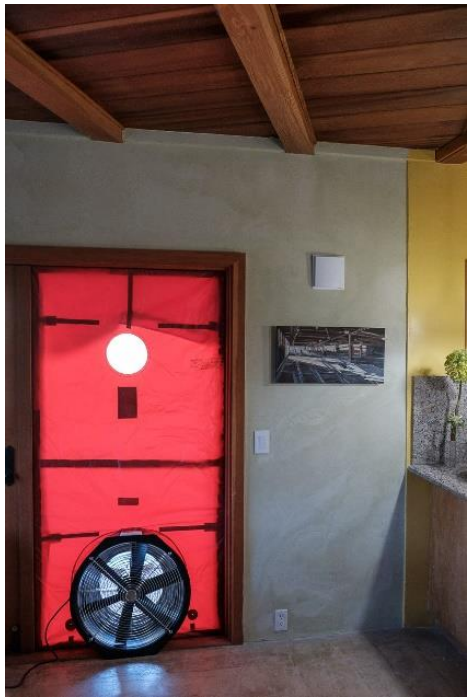
Evaluating for Highest Benefit and Opportunity

N.E.P.O.
Need – Establish – Plan – Objective

CONSIDER:

- Owner Complaints or Concerns
- Visual Clues:
  - lack of insulation, infrared
  - Age of windows
  - mold growth/smell
- Blower Door /Duct Testing
- Existing Utility Bills
- Existing Fuel/Energy Sources
- Thermal Imaging
- Energy Audit





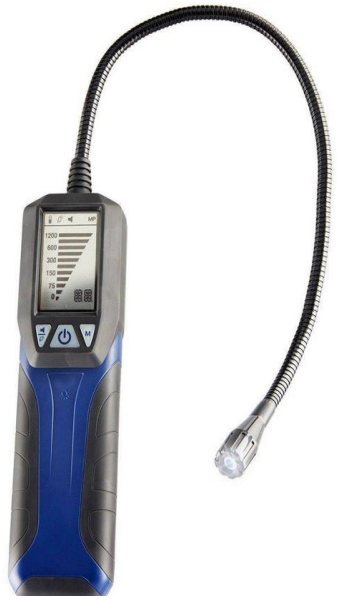
Helpful Tools

“BPI Kit” approx $4800

Varies: $15 - $120 Typical

$500

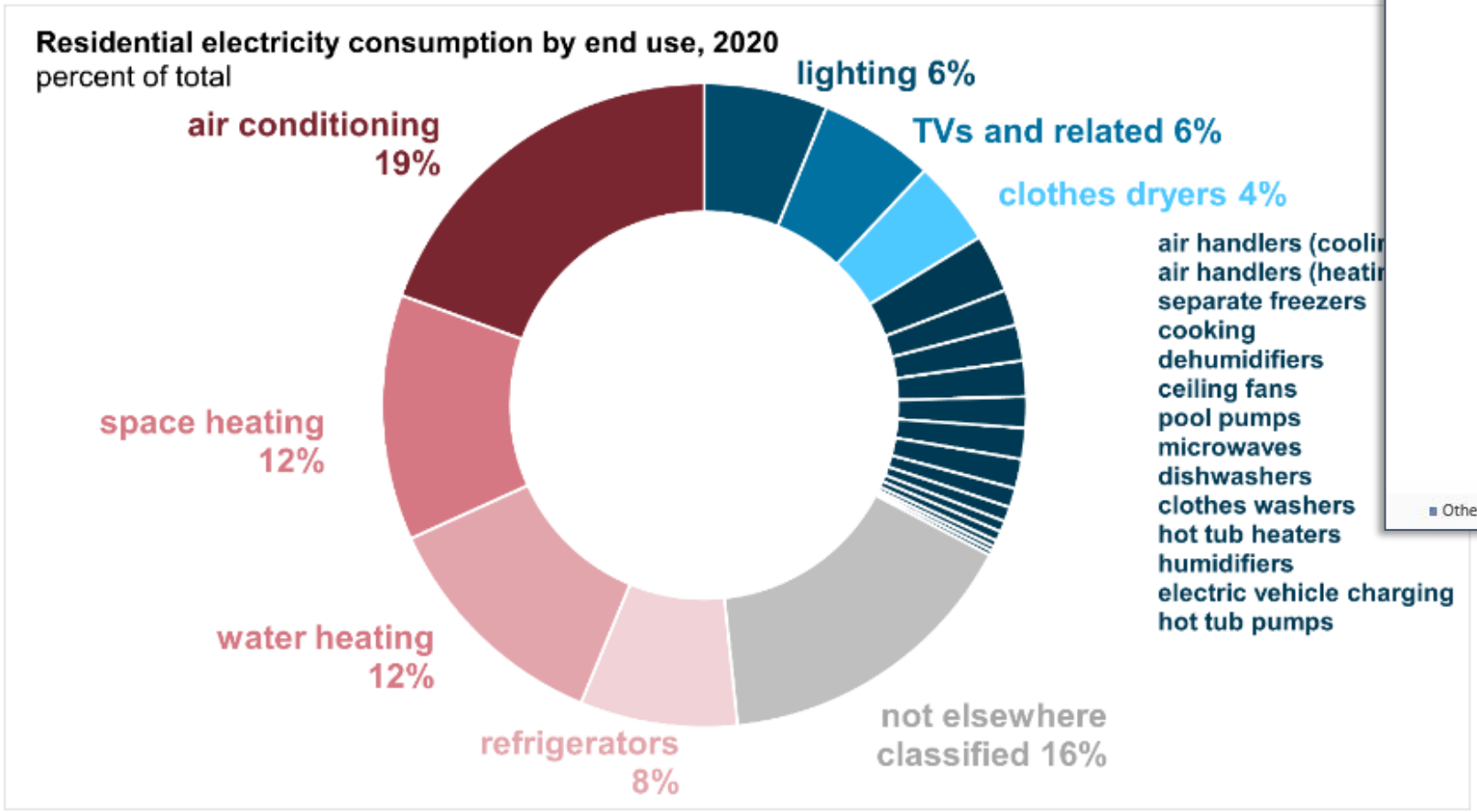
$3000 +

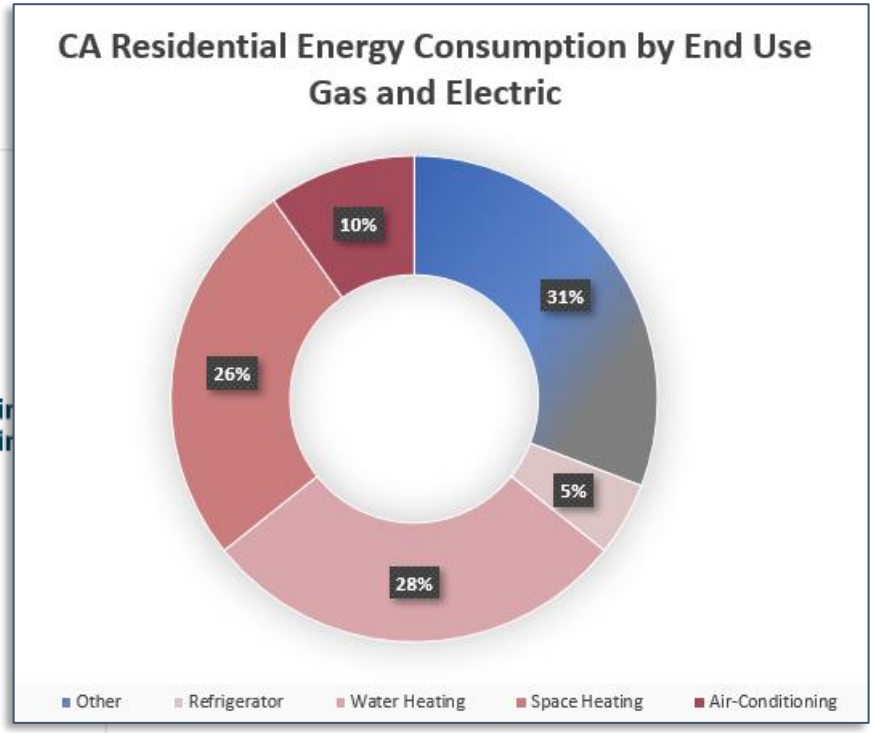


Wöhler GS 300 Gas Sniffer

$250 plus

Energy Use in Homes

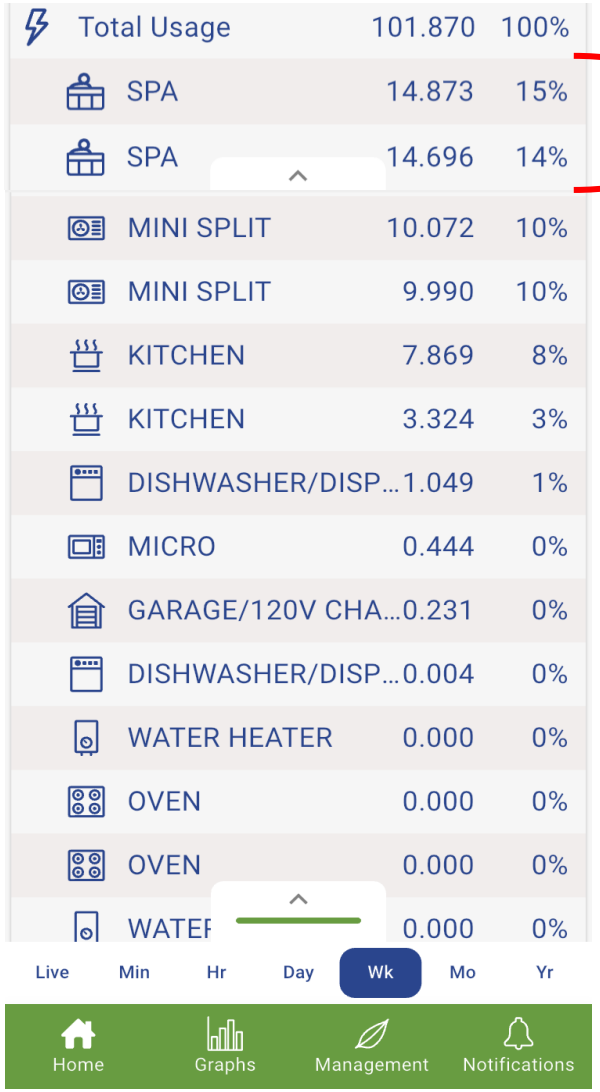




Data source: U.S. Energy Information Administration, 2020 *Residential Energy Consumption Survey* (RECS)

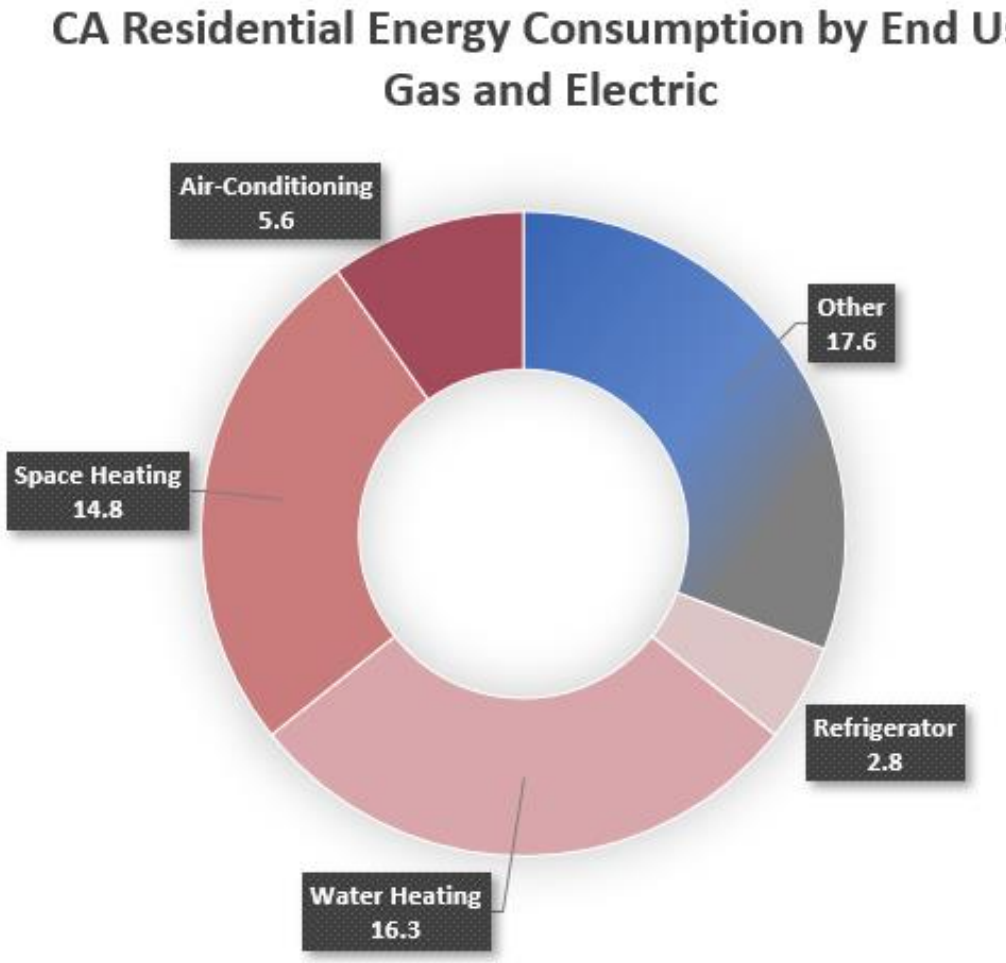
Each home will have a unique mix of Energy Use

- Screenshot of Electrical Energy Use for the beginning of a week in April.
- All-electrical home, with grid tied solar and no battery storage…yet?



- Owner's beloved Spa was the largest energy use so far for this particular week
  - Approx half was grid electricity and half was solar electricity, for a total of 29%
- Mini-Split includes space heating and hot water
- Approx 39% of the electrical energy use is for other plug loads

Typical Household Characteristics –many gas appliances…



Household characteristics

53.7
Total site consumption per household (MMBtu)

64%
Natural gas as main space heating fuel

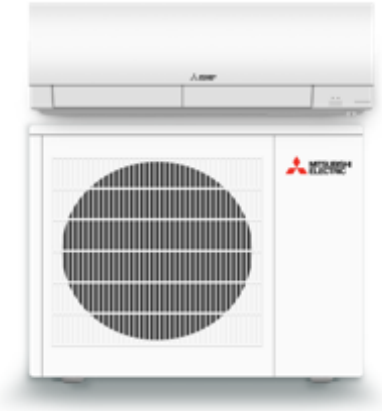
8%
All-electric households

72%
Households that use air-conditioning equipment

eia Residential Energy Consumption Survey (RECS) Dashboard

Energy Consuming Systems – *Energy efficient electric options*

- HVAC - Ducted and Ductless
  (Ducted Air-Handler and Mini-Splits)
- Domestic Hot Water –Heat Pump Water Heaters
- Ranges, Cooktops and Ovens –Induction and Electric
- Laundry- Clothes Dryers – Electric, Condensing, Heat Pump



Building Evaluations and Occupant Needs

Should we begin with an Energy Audit/Systems Evaluation?

- Energy Consultant
- HERS
- BPI
- Test in/Test out?
- They’re friendly!

YES!

HERS Rater prepping for a duct leakage test!

Top Strategies & Talking Points

Energy Savings Perspective:

- HVAC Upgrade *w/ fuel switching*
- DHW Upgrade *w/ pipe insulation*
- Insulation Upgrades *w/ air Sealing*

Comfort Perspective:

- Window Upgrades – *not* glazing replacements
- Insulation Upgrades + Air Sealing
- Filtered Fresh-Air Exchange System

Aesthetic/Design Perspective:

- Window Upgrades
- Daylighting Improvements
- Lighting and Controls Upgrade

Top Strategies & Talking Points

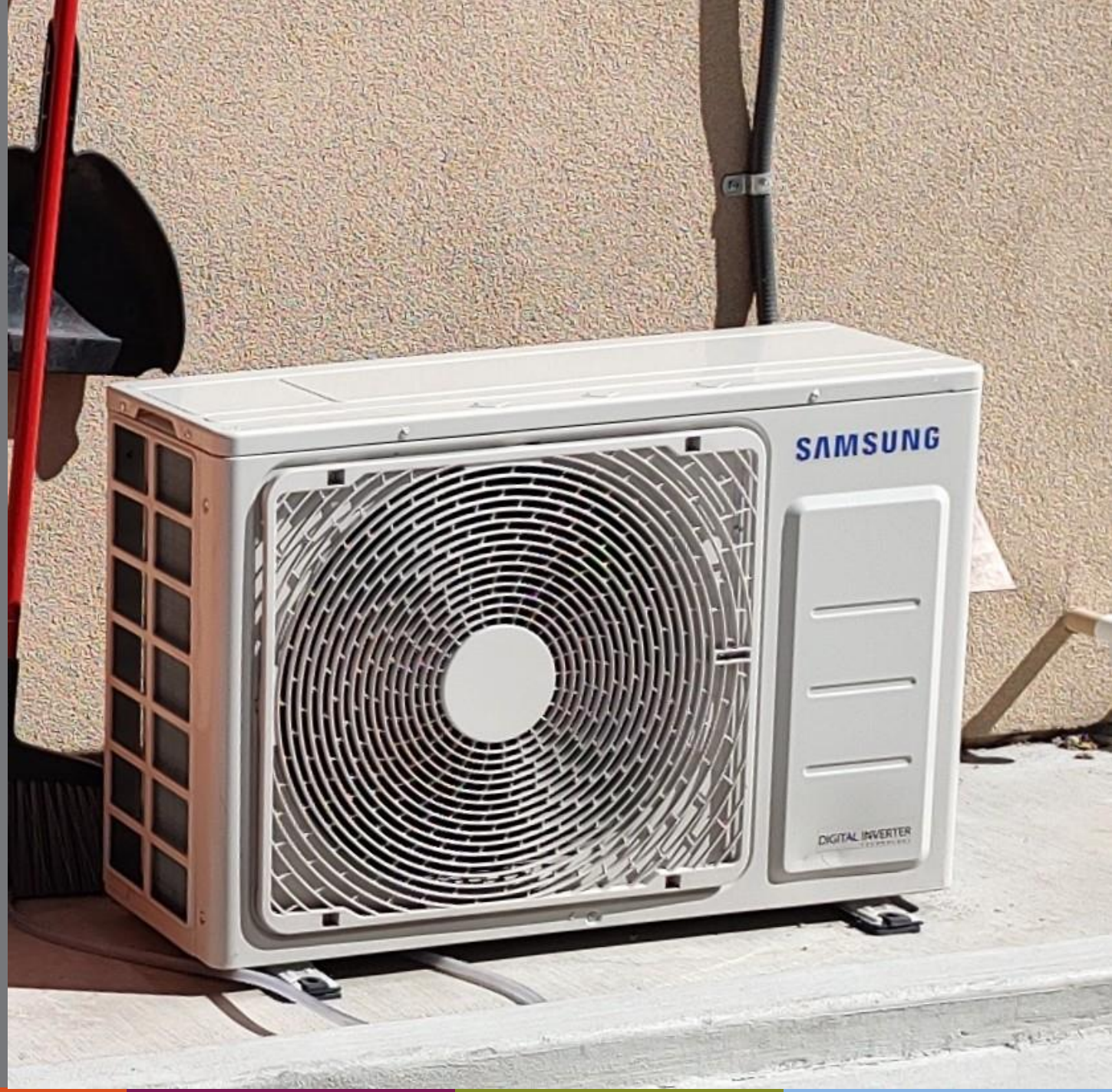
Health Perspective:

- IAQ Ventilation Upgrade
  - Controlled Outside Air
  - CO Management/Prevention/ Eliminate Combustion
- Moisture Mitigation
  - Mold Removal and Prevention
  - Bath Fans with Humidistat
  - Air-Seal Crawl Spaces

Resiliency and Durability Perspective:

- IAQ and Moisture Mitigation –above
- Battery Back-up
- Non-vented Attic
- Controlled Vented Crawl Spaces

Heating/Cooling and Ventilation Equipment



HVAC Gas Furnace or AC – Opportunity or leave as is?

Assessment:

- CO / combustion gas management
- Functionality
- Age and efficiency
- Location

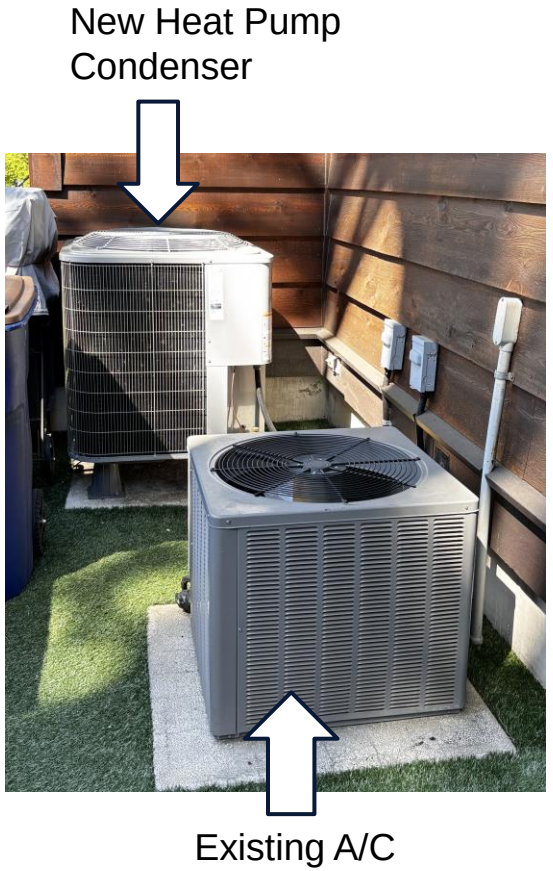
Solution(s):

- Leave-in-place or Repair
- Remove and Replace:
  - Install ducted or ductless heat pump
  - Install “dual fuel” - new heating coil connected to heat pump

Example - “Dual Fuel” with Added Fan Coil to New Heat Pump

Assessment:

- Ownership wanted to reduce dependance on fossil fuels. Solar was a consideration.
- Large Home with Extensive Duct Layout
- Ducts in good condition
- Furnace needed replacing
- Cold Climate (Winter snow)
- Brand / Manufacture Offered Dual Fuel Replacement Options



Example – Existing Home, New Heat Pump System

Indoor Wall Mounted - Bedroom

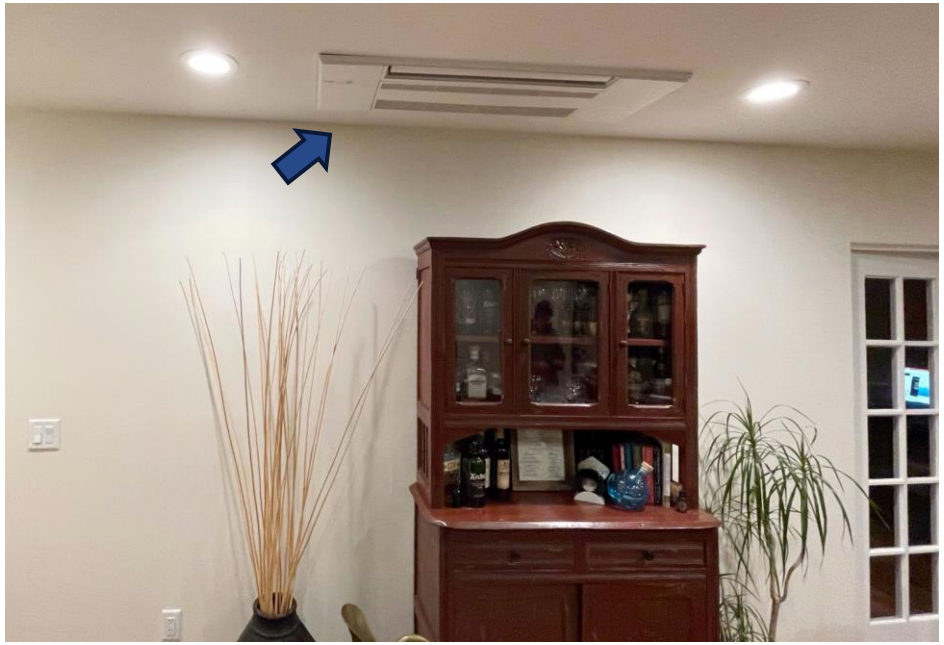
Refrigerant and Communication Line Set – Raised Floor

Outdoor Condenser

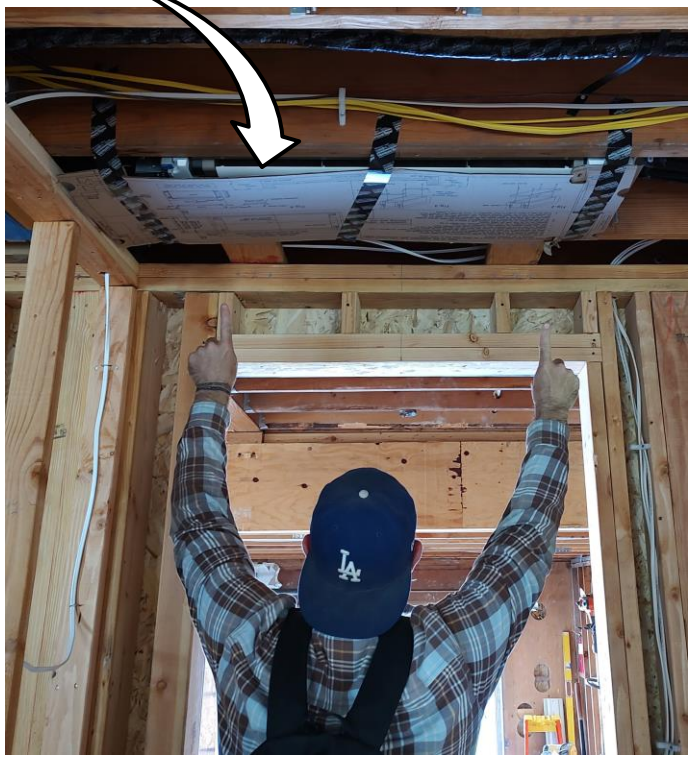
Assessment:

- Furnace Abandoned (Cracked Heat Exchanger)
- Ducts in Terrible Condition

Example – Ceiling Recessed Ductless Indoor Unit



Ductless Recessed-Ceiling



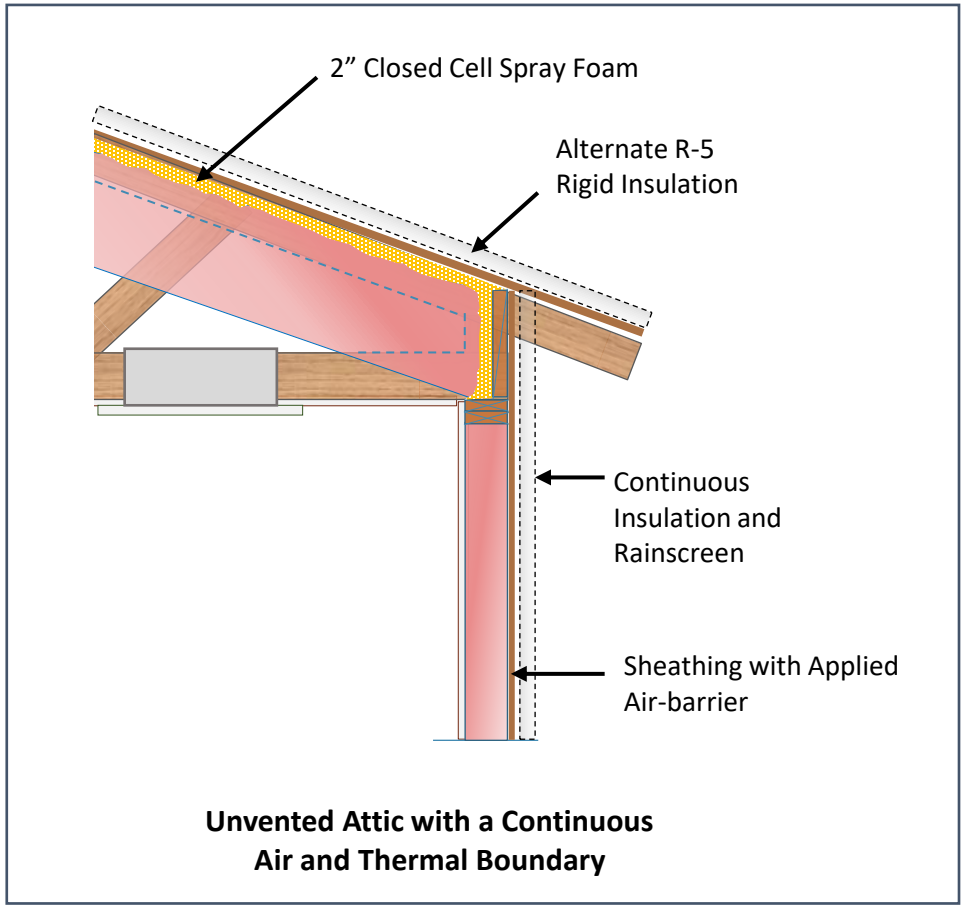
Ductless recessed-ceiling unit placed prior to insulation installation.

Assessment:

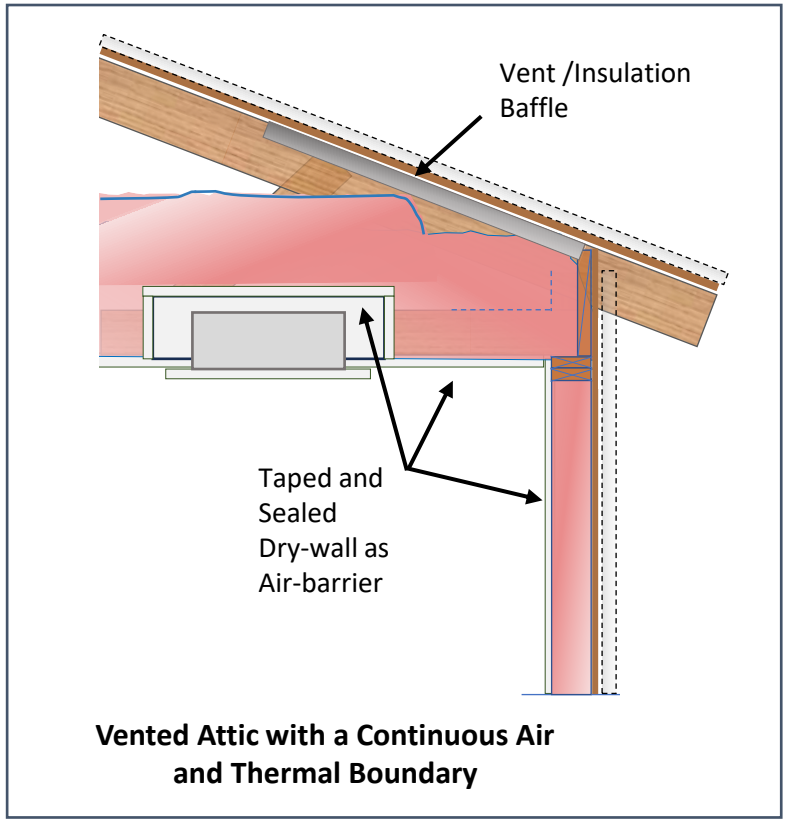
- Furnace at end of life
- Owner wanted heating and cooling, i.e. air-conditioning
- Owner did not want wall mounted units

Installing Heat Pump System with Recessed Ceiling Units

Indoor units shall be installed within the air and thermal boundaries



Unvented Attic with a Continuous Air and Thermal Boundary



Vented Attic with a Continuous Air and Thermal Boundary

Water Heating and Appliances

DHW Electric Tank – Opportunity or leave as is?

Assessment:

- Functionality
- Age and efficiency
- Location

Solution(s):

- Leave-in-place / Replace with Same
- Remove and Replace:
  - Install integrated heat pump
  - Install split system heat pump

Electric Tank – Leaking at base

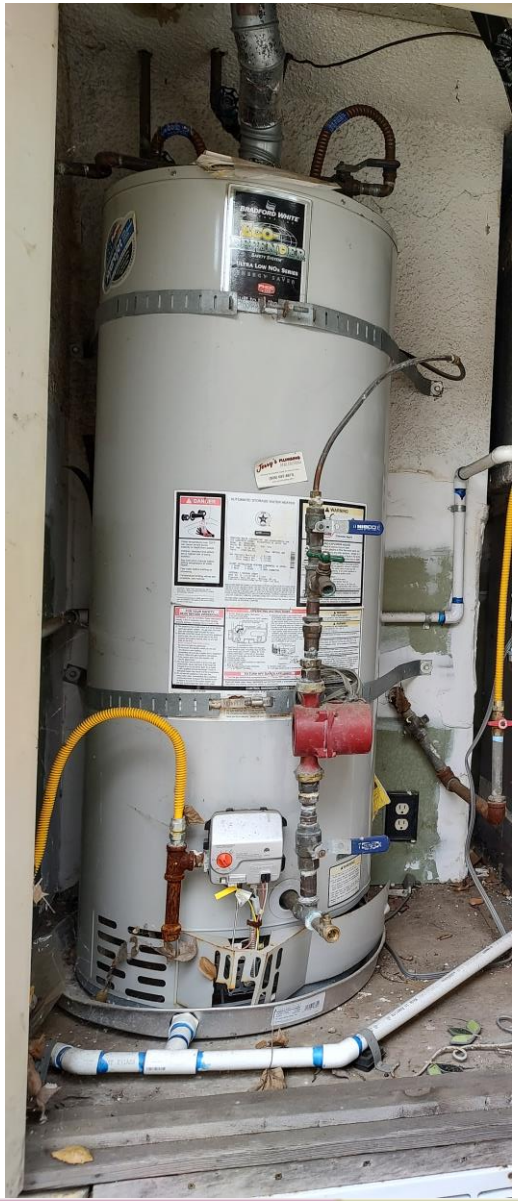
DHW Gas Tank / Tankless – Opportunity or leave as is?

Assessment:

- CO / combustion gas management
- Functionality
- Age and efficiency
- Location

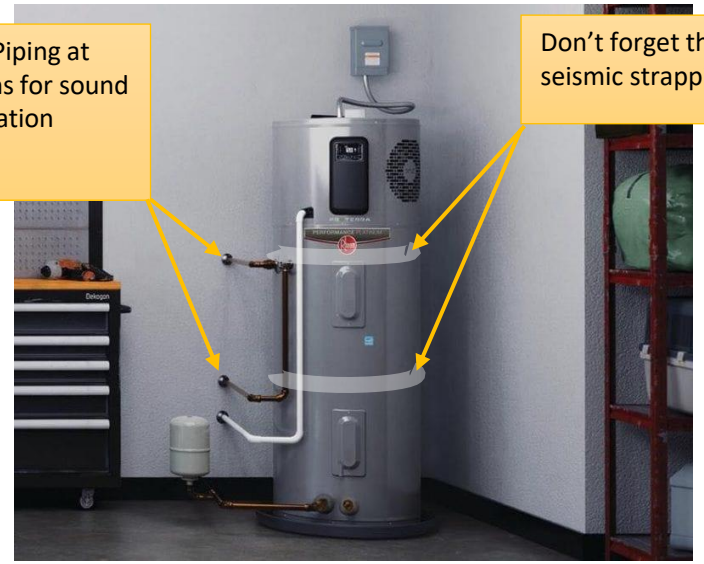
Solution(s):

- Leave-in-place
- Replace with higher efficiency
- Remove and Replace:
  - Install integrated heat pump
  - Install split system heat pump

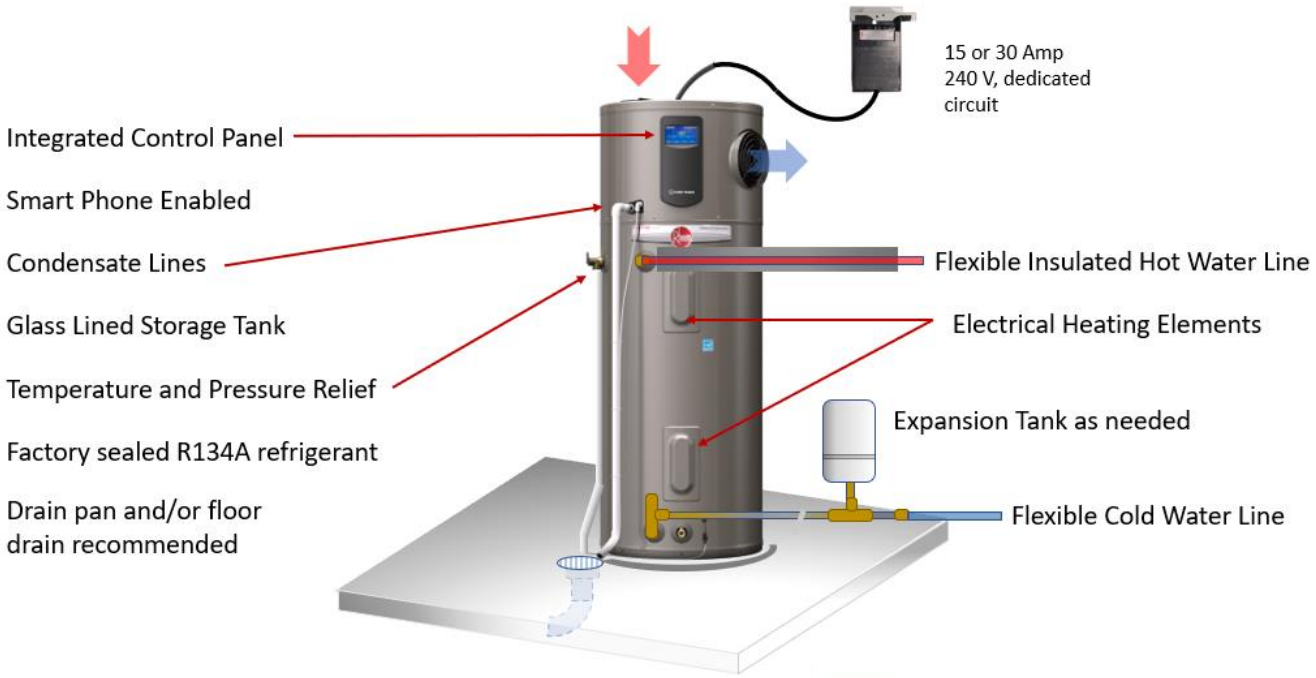


Integrated HPWH Considerations

- **Integrated HPWH tanks taller than standard gas or electric units**
- **Sound Level is typically around 50 db**
- **Cold dehumidified air is expelled**
- **Condensate Drainage needs to be addressed**
- **Needs 700 – 1000 cubic feet volume, or ducted vent kit, newer models only need 450 cu ft**
- **Operating temperature starts around 45 deg F, some models 37 deg F**



Rheem marketing



Kitchen Remodel –new appliances

Induction Ranges, Cooktops and Electric Ovens

GE Café offers a ‘retro’ look that some people may prefer.

Note: Look for sale prices, Frigidaire Induction Range often priced to be competitive with gas models

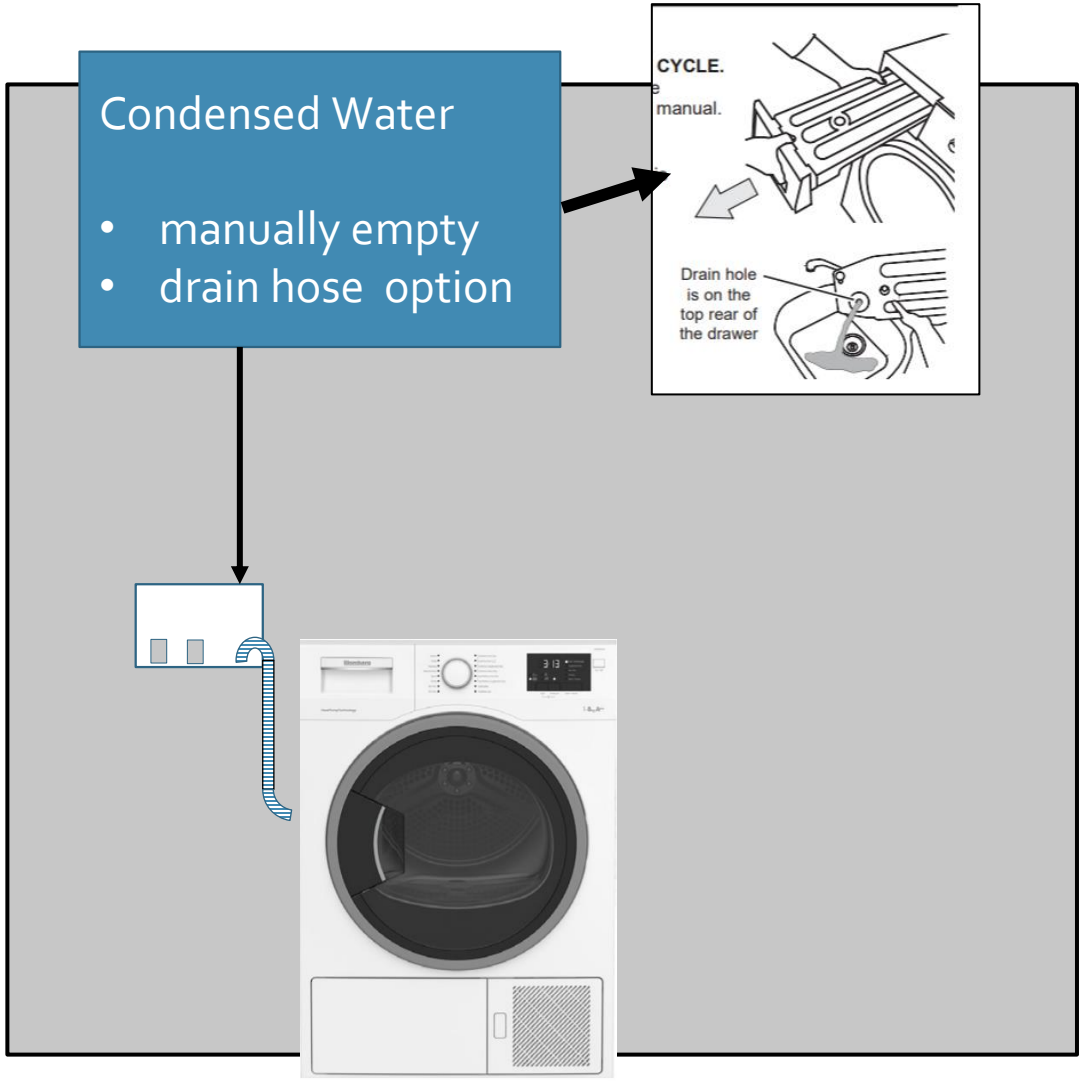
Energy Star Refrigerators –LG comes with Inverter Compressor (i.e. variable speed.)

Examples – All-Electric Kitchens

Laundry Remodel –new appliances

Condensed Water

- manually empty
- drain hose option



Heat Pump and Condensing Dryers

Ventless Condensing Dryers / Washing Machines 2-in-1

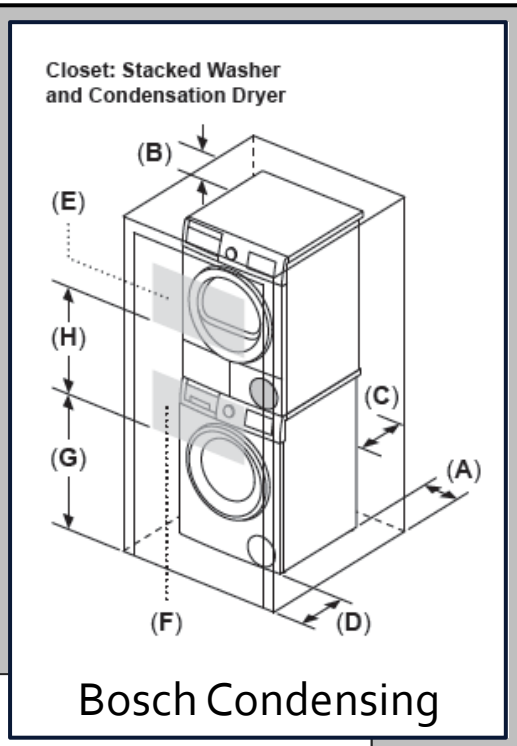
Remodeled Bathroom with Laundry Alcove

Background: *Apartment Remodel; ventless laundry added to new larger bathroom.*

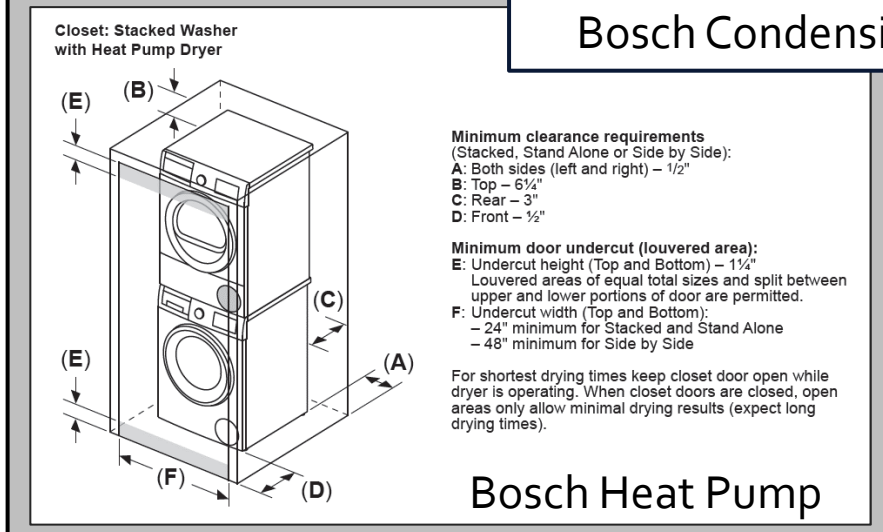
Issue*: Laundry not drying with doors closed*

Response: *Keep doors open or replace w/ louvered doors and/or vent the space*

Bosch condensing dryer Installed. Dwelling designed for Bosch heat pump dryer



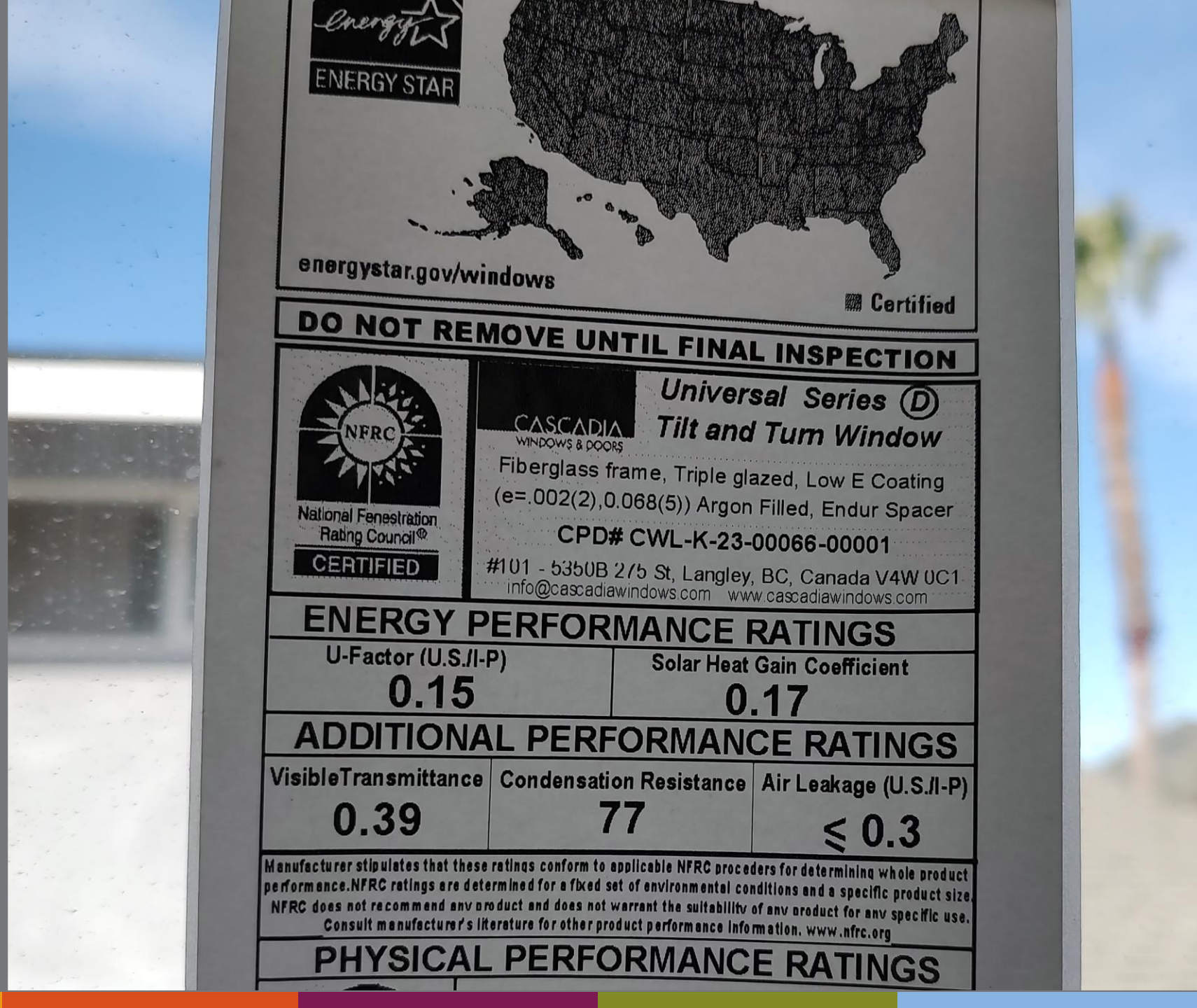
Bosch Condensing



Bosch Heat Pump

Bonus: Bosch heat pump dryer only $300 more and comes with self cleaning condenser coil.

Windows, Walls, Attics and Floors



Existing Windows and Walls – Opportunity or leave as is?

Assessment:

- Wall Assembly: Insulation
- Glazing: Single / Double / Low-e2
- Frames: Metal / Thermal-Break / Wood / Other
- Location: Solar Gains / Daylight / Views

Solution(s):

- Walls: Improve Insulation
- Windows: Leave-in-place
- Windows: Remove and/or Replace

Existing Windows –Metal Framed and/or High SHGC

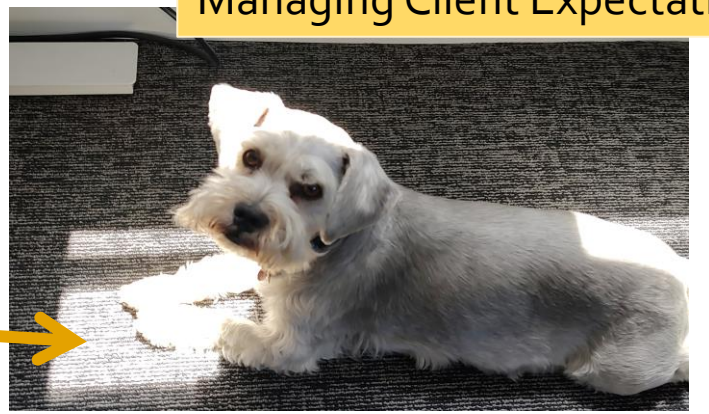
(E) Windows – Non-thermally broken metal frames

104.5 deg. F at the frame

66 deg. F at the wall

Note:
Interior frame temperature is an indication of exterior surface temperature.

Managing Client Expectations

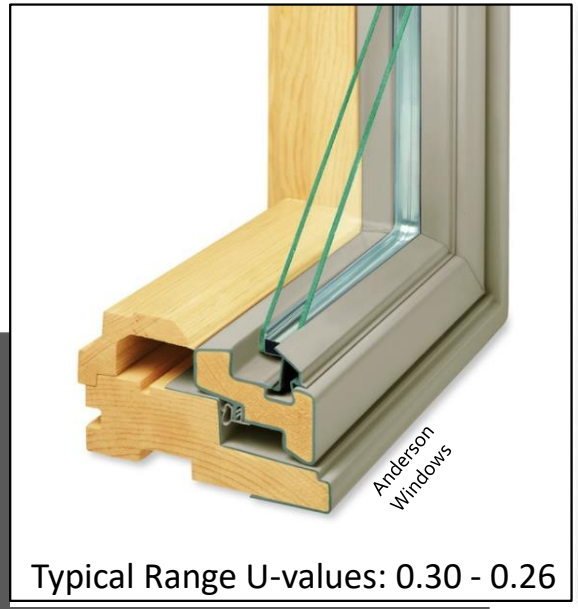


107 deg F at the floor. Nice and Warm!?

Note:
Older (E) windows may have higher solar heat gain coefficient (SHGC) glass and 'accept' more solar heat/warmth as compared to (N) windows with low SHGC glazing.

Window Options – Higher Performance or Code?

Just about all brands of windows offer dual or triple paned options



Typical Range U-values: 0.30 - 0.26

U-values: 0.28 to 0.20

Options:

- Dual Paned Low-e
- Triple paned Low-e
- Air/Argon/Krypton
- Thermally Broken
- Visible Transmittance
- Sound Transfer

…with many brands offering values as low as U-0.14

Reminder
2022 Code: U-0.30 for all CZs

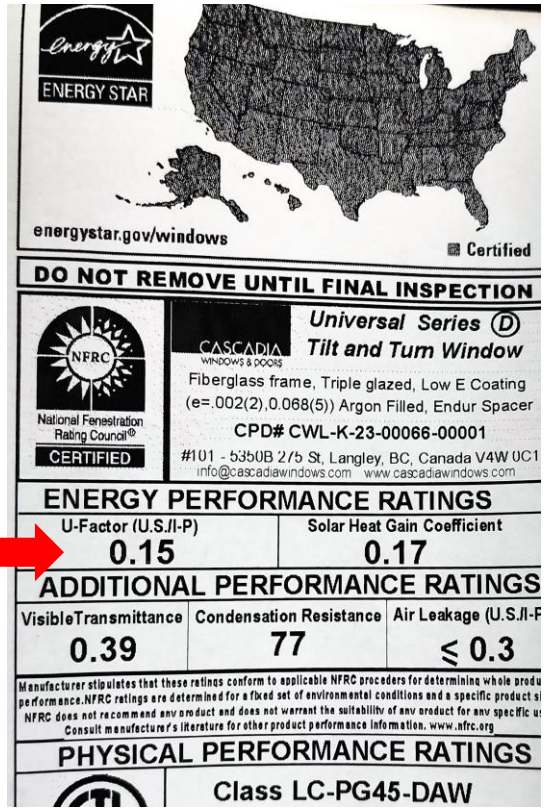
Sidebar

2025 Code Update:

- **U-0.27** decreased for CZ 1-5, 11-14, and 16
- **U-0.30** no change for CZ 6-10 and 15

Exception: New dwelling units with a conditioned floor area of **500 sf** or less in **CZ 5** may comply with a max **U-0.30**.

Example –High Performance Window with “Padded-out” Wall



Window Cost Comparison

	Panes	U-Factor	Delivered Cost
Alpen			
	Double	0.15	$75,878.51
	Double	0.16	$85,311.14
Andersen			
A-Series	Triple	0.23	$135,873.69
Loewen			
Alum Clad	Double	0.25	$152,826.18
Marvin			
Essential & Ultimate Drs	Double	0.29	$118,620.61
SeemRay			
	Double	0.21	$64,000.00
SmartWin			
	Double	?	$128,469.00
WeatherShield			
	Double	0.24	$99,873.00
Wythe			
	Triple	0.14	$91,702.00
Zola			
Classic-Clad	Double	0.25	$114,189.00
Cascadia			
	Triple	0.14	$70,557.00

Attic and Roof – Opportunity or leave as is?

Assessment:

- Roof Assembly: Structural Integrity / Adequate Ventilation / Unvented Assembly
- Roofing: Replacement Time?
- Insulation: Quantity / Quality / Location
- Radiant Barrier: Condition / Location

Solution(s):

- Improve Insulation: Top of Roof Deck / Under Roof Deck / Ceiling
- Reroof with/without Rigid Insulation
- Consider WUI Gable/Dormer Vents

Attic Ceiling Insulation – Opportunity or leave as is?

Assessment:

- Vented Attic
- Existing R-19
- Not Reroofing - yet

Solution(s):

- Add blow-in over the top to bring up to Current Code or better

Blown-in Cellulose
DYI Solutions at Lowes and Home Depot

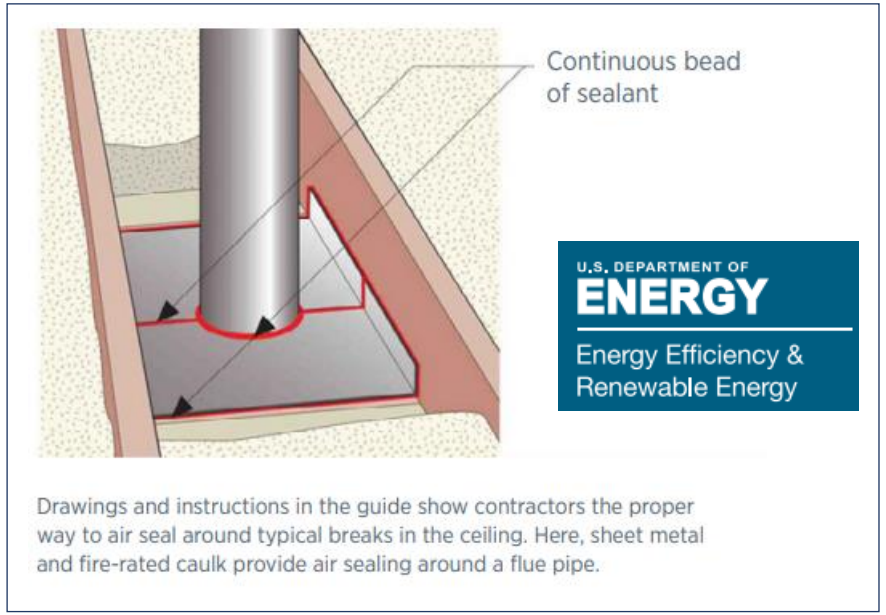
Note:
Caveat – confirm structural integrity of ceiling joist with older home construction –Cellulose may be too heavy.

Existing Attics, Ceilings –Opportunity and the Code

Solution(s):

- Air-Seal First!
- Upgrade light fixtures to air-tight insulation-contact (ATIC) rated or use fire-proof cover
- Reminder: Build drywall box, sealed and taped for ductless ceiling-recessed mini-split
- Use insulation that meets R-value and weight constraints

Altered Ceiling of Vented Attics

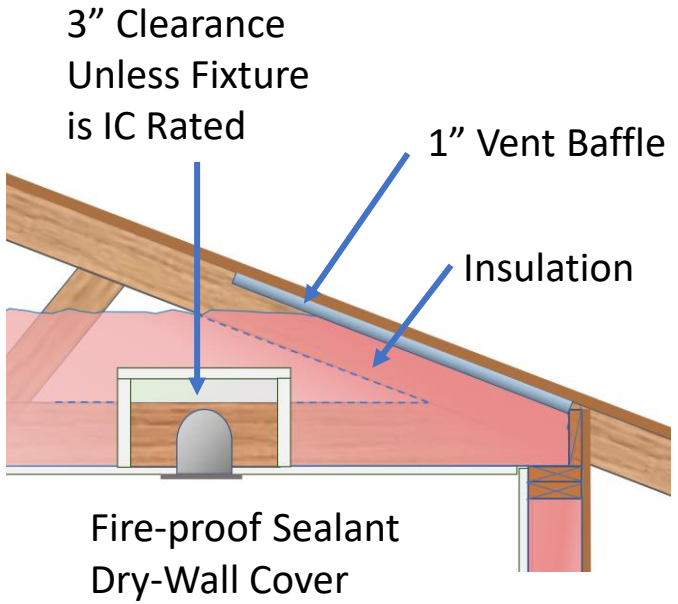


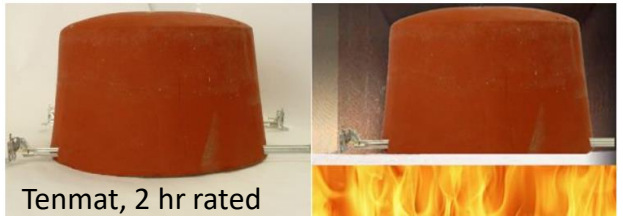
Drawings and instructions in the guide show contractors the proper way to air seal around typical breaks in the ceiling. Here, sheet metal and fire-rated caulk provide air sealing around a flue pipe.

NOTE:

Altered ceilings shall be insulated to R-49 in CZ 1-4, 6, 8-16 *[not CZ 5 and 7]*

- Except for CZ 1, 3, and 6 with existing R-19





Manufactured Cover

Raised Floor – Opportunity or leave as is?

Assessment:

- Insulation: Location / Condition / Quantity
- Adequate Ventilation
- Water or Moisture Present
- HVAC or DHW Appliances Present

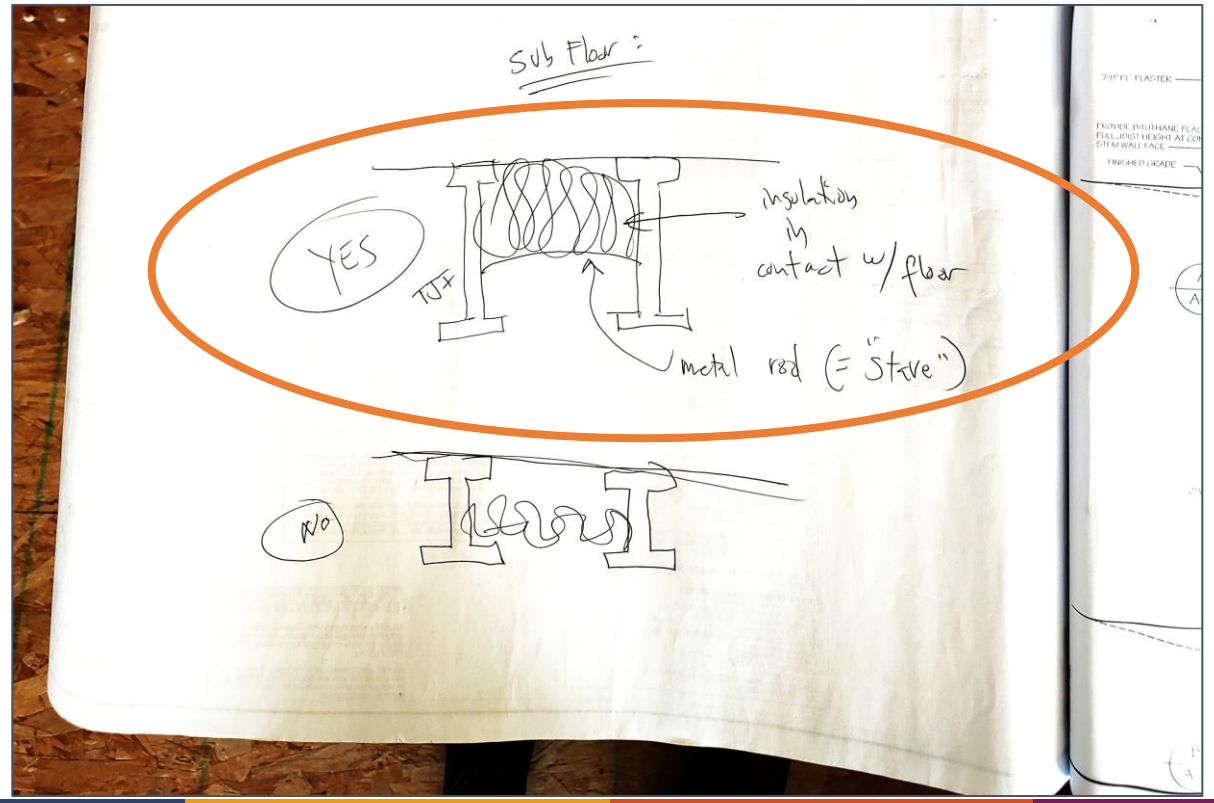
Solutions:

- Spray applied vapor retarders / air barriers
- Class I/II vapor retarder, taped and sealed
- Sump pumps
- Mechanical ventilation with humidistat
- Insulation at Floor Deck
- Unvented – Insulation at perimeter foundation wall and rim joist

Raised Floor Example – R19 Insulation

Assessment:

- Raised Floor Addition / ADU
- R-19 or Better, Code Compliant
- Improper Insulation Location, i.e. installed towards bottom of floor joist vs directly under floor deck with no air space



Friendly HERS Rater,

"Insulation Placement Matters"

Raised Floor – Vapor Barrier at the Ground/Floor

Assessment:

- Uninsulated Raised Floor
- Exposed Ground and moisture present

Reduce Air Leakage – Additional Opportunities

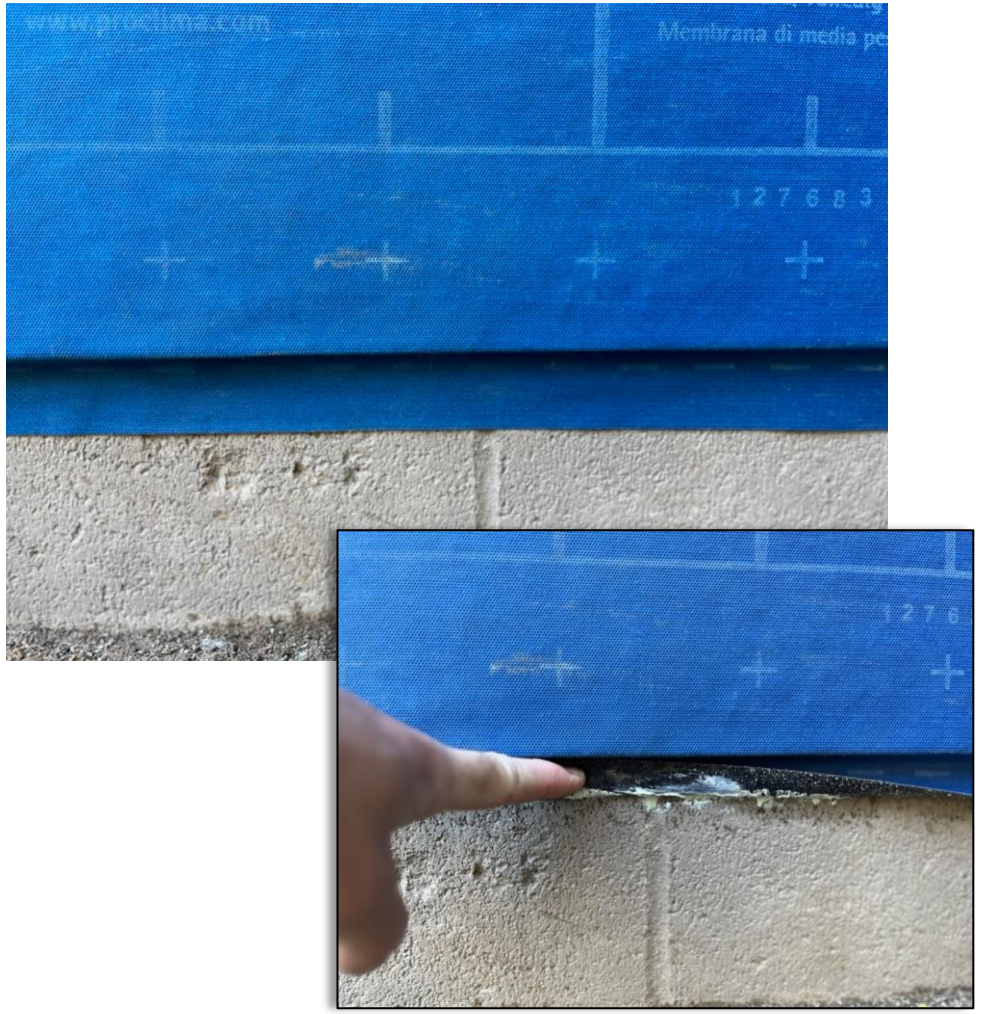
Assessment:

- HERS Existing Conditions
- Infrared Camera
- Blower Door Testing

Solutions:

- Caulk Sill Plates
- Seal around windows while trim is off
- Attention at junctions

‘Ideal World’ – Air-Barrier from the Exterior



Remodel –Air Barrier from the Interior

1

2

3

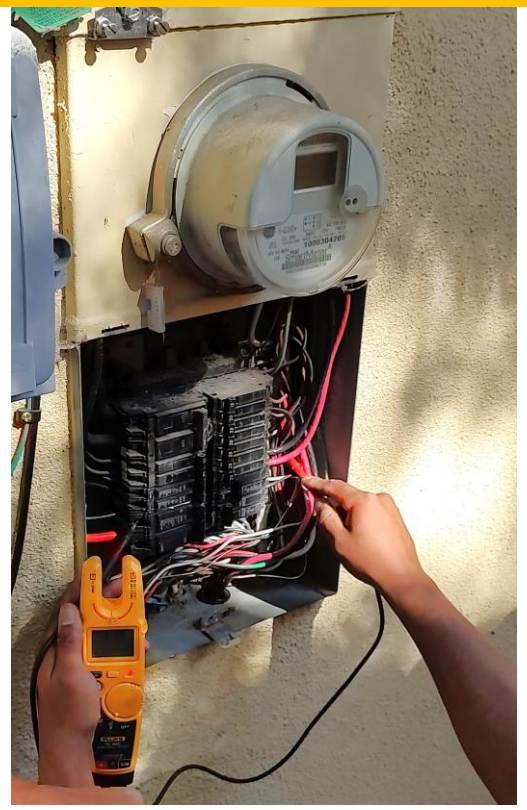
Solar PVs and Battery Storage

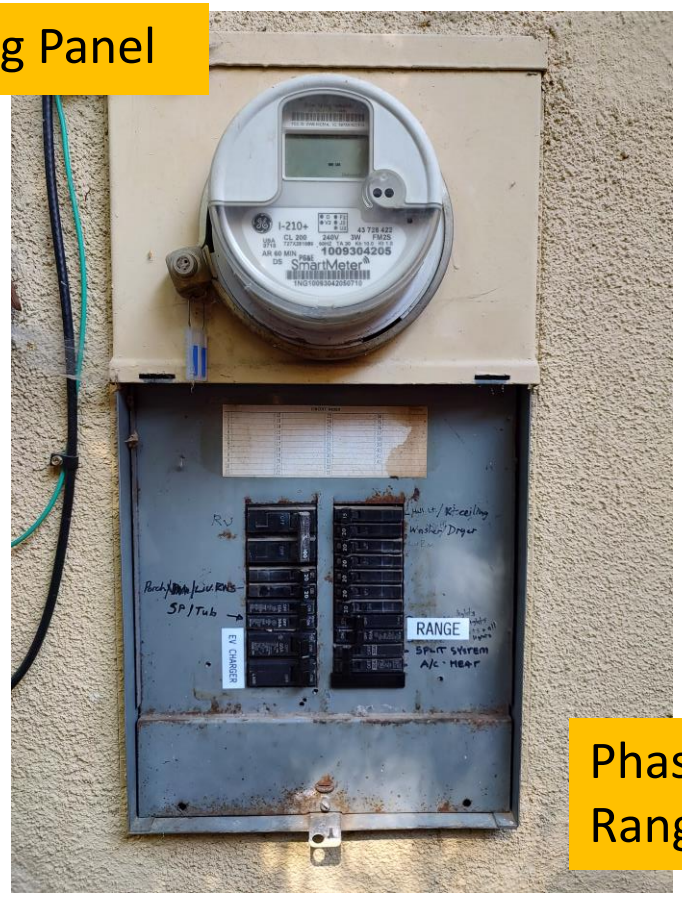
Electric Panel Upgrade Needed?

Assessment:

- Panel Size / Capacity
- Adding Electric Loads –all at once or in stages
- Adding Solar and/or Battery

Phase 1: Reorganize Existing Panel

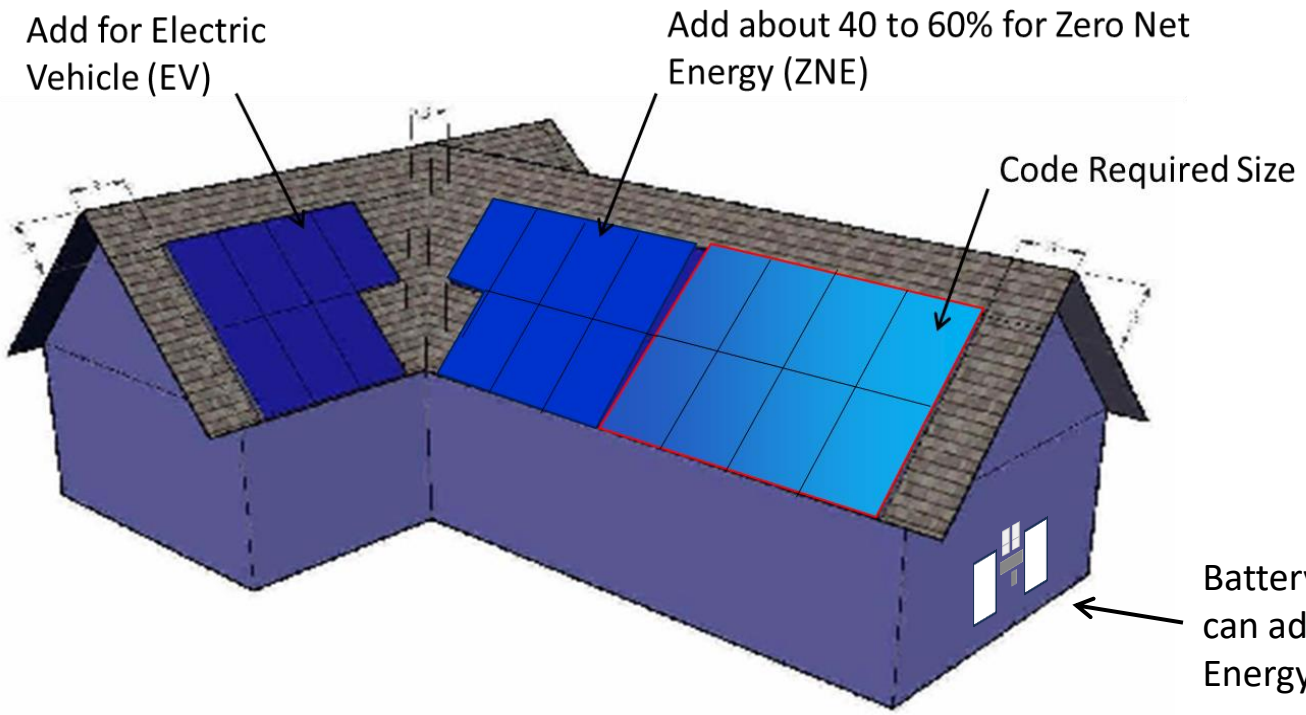




Phase 2: New Elec Panel with Solar and Battery Storage

Phase 1: EV Charger, Induction Range, and HP Space Conditioning

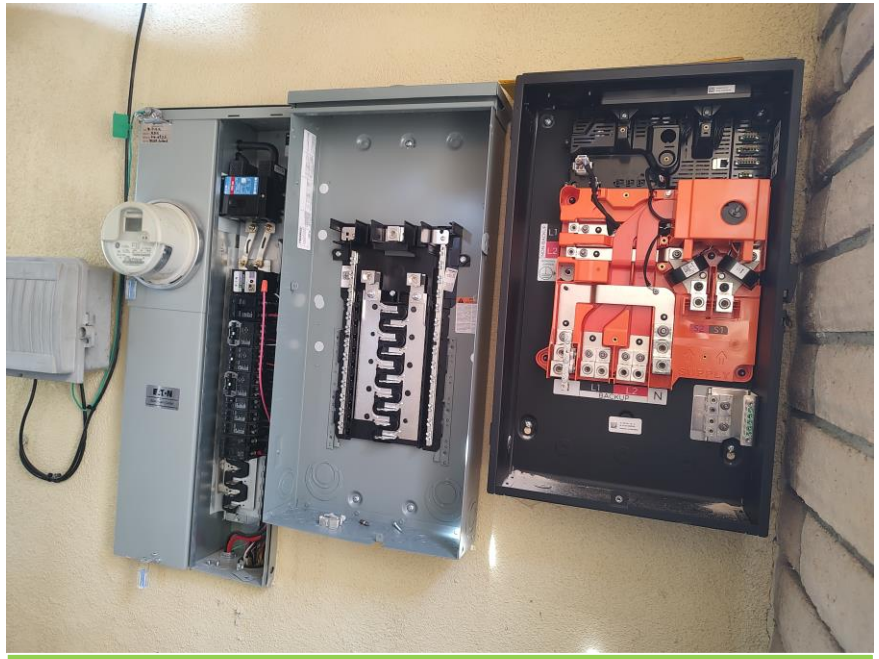
Zero Net Energy (ZNE) *–the energy a home uses in one year is equal to the energy produced on-site for that year*



Under the new electric pricing system (NEM 3), a solar PV system with battery storage can be more cost effective than a PV System alone for a ZNE home.

For Example: New Construction 2000 SF home in Atascadero (climate zone 4) a 2.38 kW system would be required.
Santa Barbara and Ventura coastal areas would be slightly less.

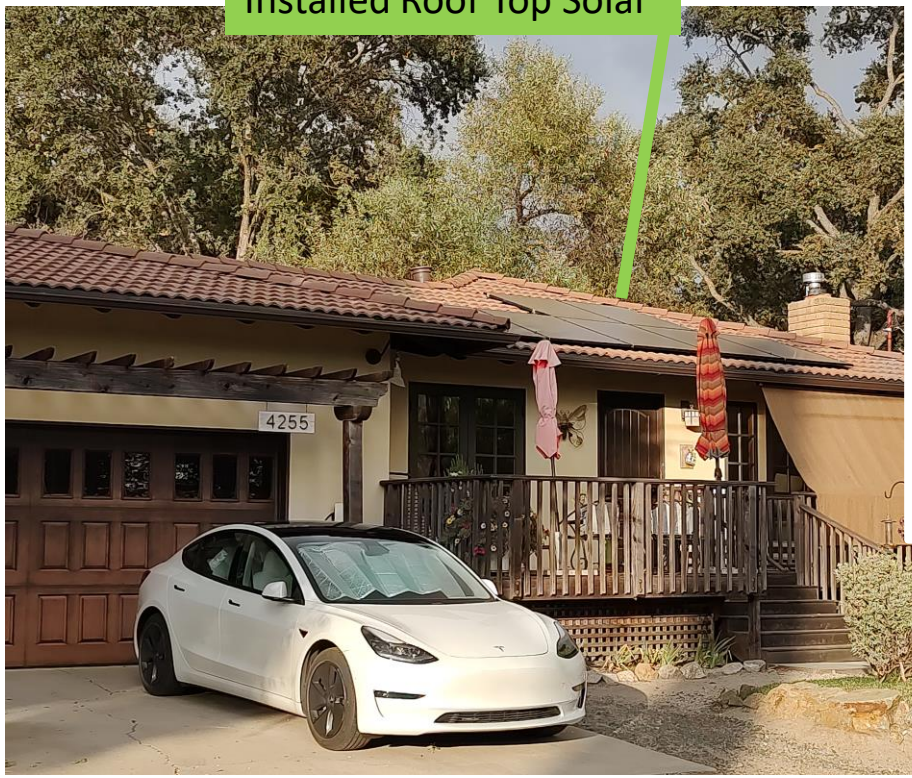
Existing Homes: Solar PV and Battery Systems



New electrical panel, sub-panel and controller.

Considerations:
New roof or re-roofing / repairs needed?
Panel upgrade needed –additional costs?
Solar access / shading on roof?

Occupant Habits: Energy Usage, Solar PV and Battery Systems

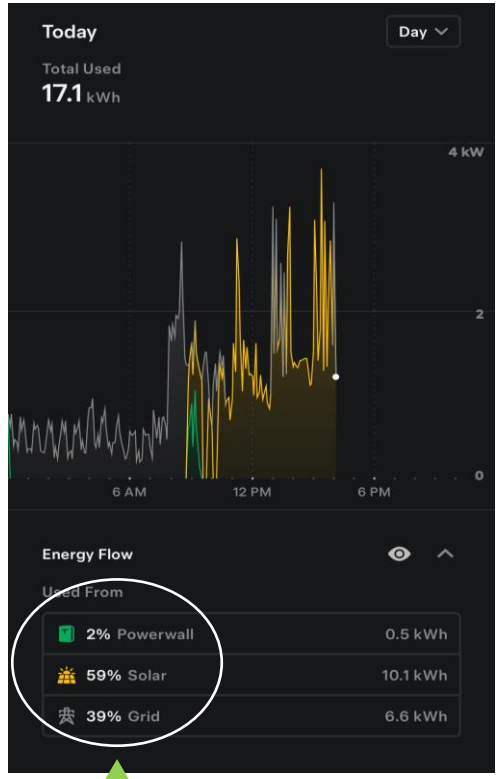


Installed Roof Top Solar

Depending on one's driving milage, electric cars can add significant loads.

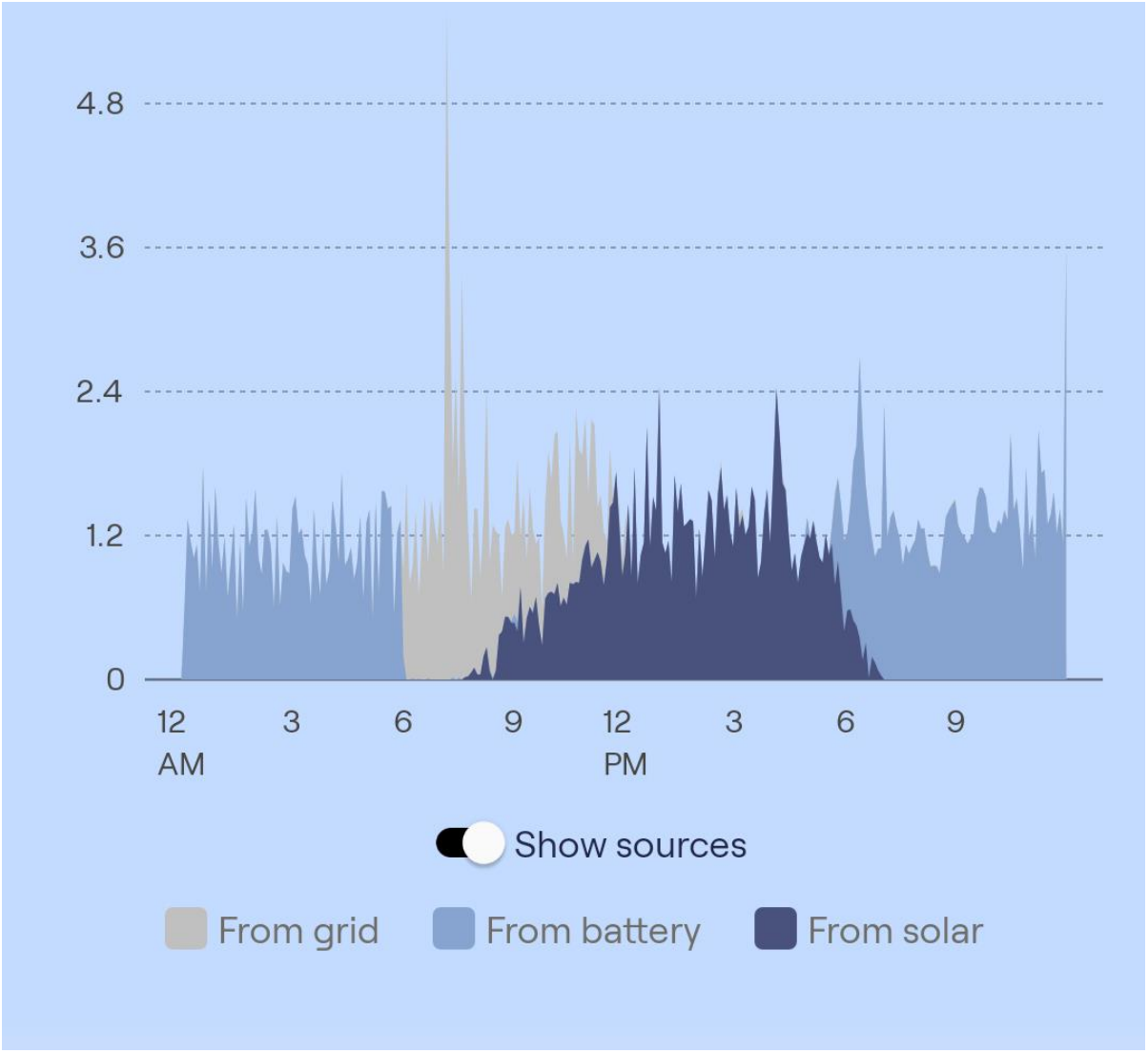
Battery Storage: Two batteries are providing whole home back-up – for the most part…

Electric dryer – Multiple consecutive use can add significant electric load, pulling energy from the grid.



"Laundry Day"– Solar only met 59% of the need that day –battery recharge has "priority" on solar energy.

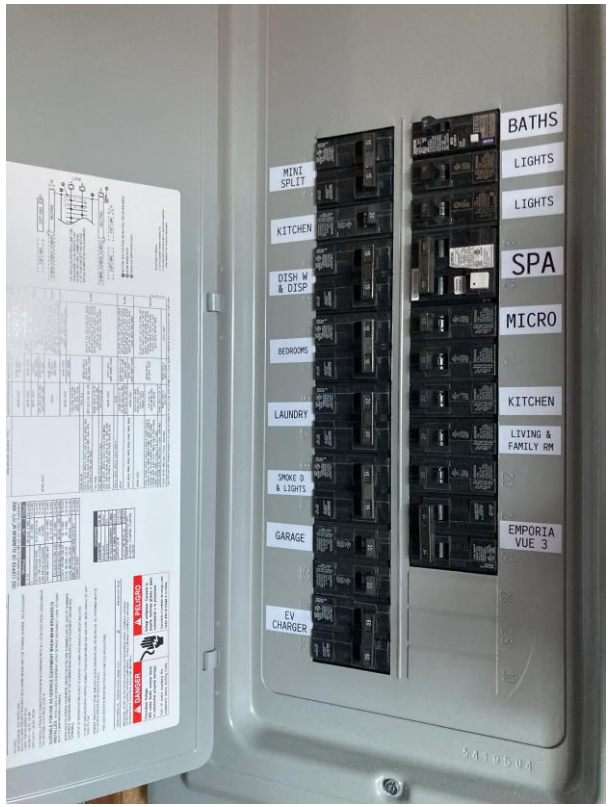
Managing Client Expectations

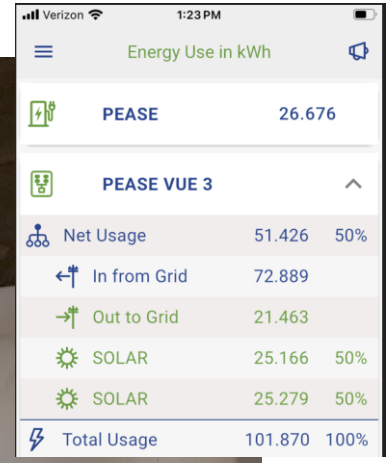


Some Take-Aways:

- Some days, even with Solar and Battery Storage, the household will use ‘grid’ electricity.
- Will have an electric bill.
- Many days my car ‘charges’ on solar and that saves me over $100 /month.

Electrical Panel Upgrade, Car Charging and Remote Monitoring





Sizing and Cost Savings – Solar Calculator ‘WattPlan’

https://guide.pge.com

User can fine tune the battery parameters and costs

PG&E RESOURCES

Explore resources for PG&E Customers

Everything you need to reduce costs and maximize savings

RESET ALL

Solar Calculator

Make an informed decision about rooftop solar for your home. Calculate your solar savings potential with a personalized assessment with PG&E's Solar Calculator.

GENERATE SOLAR POWER | TOOLS AND CALCULATORS Start Estimate >

Disadvantaged Communities – Single-Family Solar Homes (DAC-SASH) program

Learn more about available programs for income qualified customers in disadvantage communities

GENERATE SOLAR POWER | PROGRAMS, REBATES Get Started >

Storage

Storage can increase the amount of usage you can cover with generation from your solar system.

☑ Include storage?

Energy capacity: 13.5 kWh

0.5 — 27

Power, Max Continuous: 5.0 kW

1 — 10

Unit Price: $1,000 per kWh

100 — 2000

System Price: $13,500

Benefit of Battery Storage

If you can afford the upfront costs of the battery (assumed $13,500 installed):

- Save additional $9,307 over 20 yrs
- Additional year to ‘Breakeven’
- Very low utility bill (est. $82/mo)
- Power some critical loads during a power outage

Solar only

No	41%
Backup power	Solar energy used on site, not exported

Key financials

System cost	**$15,960**
Total incentives	**$4,788**
Net savings or (costs) over the next 20 years	**$33,184**
Breakeven	**Year 6**
Current average monthly bill	**$349**
Average monthly bill after solar	**$178**

Key features

- Solar system will export excess power to receive bill credits
- Solar generation shuts down during power outages unless special inverter is used

Solar and storage

Yes	78%
Backup power	Solar energy used on site, not exported

Key financials

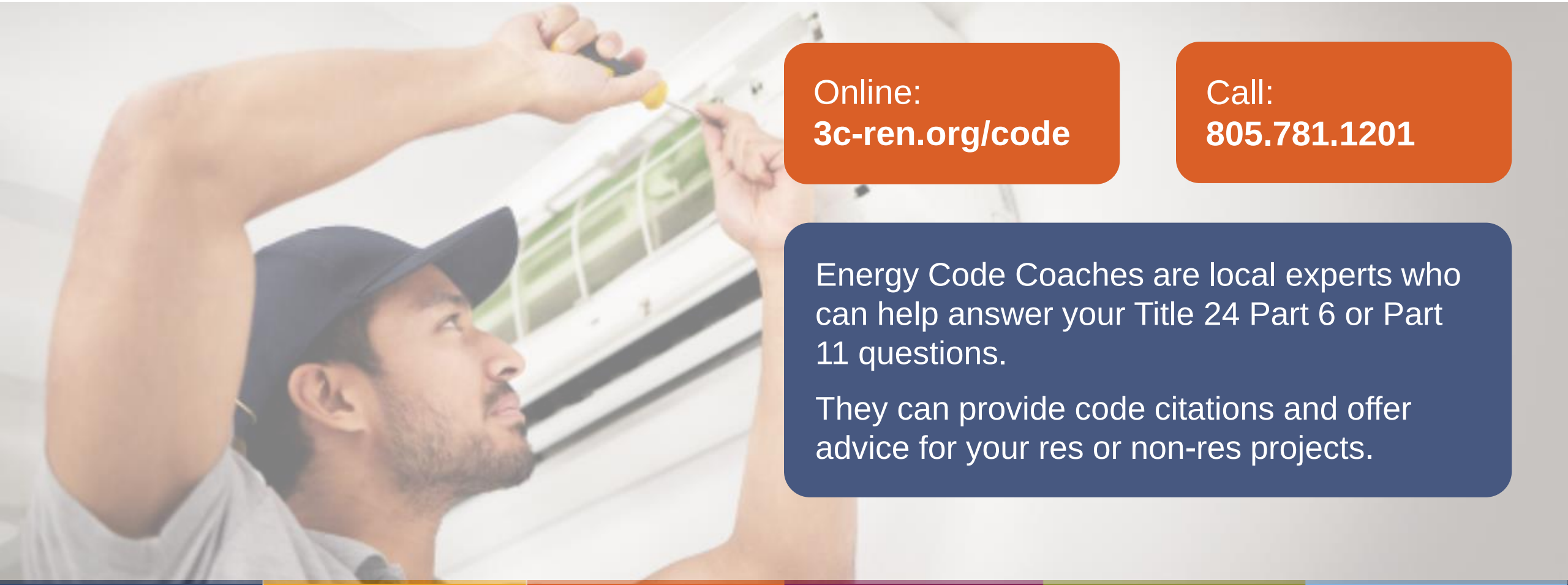
System cost	**$29,460**
Total incentives	**$8,838**
Net savings or (costs) over the next 20 years	**$42,491**
Breakeven	**Year 7**
Current average monthly bill	**$349**
Average monthly bill after solar + storage	**$82**

Key features

- Power critical appliances - or even your whole home - for a limited duration during power outages
- Use solar energy when the sun is shining, store excess solar power for use during evening peak hours, when electricity is most expensive

Questions about Title 24?

3C-REN offers a *free* Code Coach Service



Online:
3c-ren.org/code

Call:
805.781.1201

Energy Code Coaches are local experts who can help answer your Title 24 Part 6 or Part 11 questions.

They can provide code citations and offer advice for your res or non-res projects.

Closing

Continuing Education Units Available

- Contact chloe.swick@ventura.org for AIA LUs

Coming to Your Inbox Soon!

- Slides, Recording, & Survey – Please Take It and Help Us Out!

Upcoming Courses:

- Practical Ways to Address Embodied Carbon (5/1)
- Electrification Products for the Central Coast Climate (5/6)
- All Electric ADUs In-Person in Santa Barbara (5/16)
- A Builder's Perspective on Zero Net Energy (5/20)

Any phone numbers who joined? Please share your name!

Thank you!

More info: **3c-ren.org**

Questions: **info@3c-ren.org**

Email updates: **3c-ren.org/newsletter**

3C-REN

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