

Small Firm Forum:
2022 Energy Code Preview for Small Projects
6/9/22

Presented by Dan Johnson, AIA
Collaborate@BeyondEfficiency.us



Agenda

Course Description

The California Energy Code drives many design decisions and code compliance is one of the architect's responsibilities. We will look at key highlights of the forthcoming 2022 Energy Code taking effect 1/1/23, specifically for small projects such as: home remodels, additions, Accessory Dwelling Units, new single-family homes, and small commercial spaces.

Objectives, Learning Goals

Attendees will learn how to do their best work in the current energy policy environment:

1. **Good starting assumptions** for insulation levels and system types;
2. **Cost effective** and code compliance solutions for gas-free homes;
3. **Apply** specific new Energy Code rules to small projects, such as solar PV and water heating; and
4. **Learn where to go** for more specifics: Reach Codes, resources, incentives

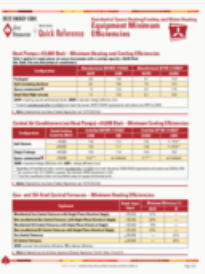
2022 Energy Code—the “What”

<https://energycodeace.com>




Ace*Resources™



An array of downloadable materials providing practical and concise guidance on how and when to comply with California's building and appliance energy efficiency standards.




Quick Reference Sheet:
Residential Minimum
Heating & Cooling
Efficiencies 2022



Fact Sheet: Single-family
Buildings: What's New in
2022



Fact Sheet: Nonresidential
Buildings: What's New in
2022



Fact Sheet: Multifamily
Buildings: What's New in
2022



Fact Sheet: What's Changed
for 2022 - Multifamily
Buildings



Filter

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Resource Type

Fact Sheet ▼

Energy Code & Regs

2022 En... & 3 more ▼

2022 Energy Code—the “What”



2022 ca energy code

[All](#) [News](#) [Maps](#) [Shopping](#) [Images](#) [More](#)

About 533,000,000 results (0.46 seconds)

<https://www.energy.ca.gov> › programs › 2022-building...

2022 Building Energy Efficiency Standards - California Energy

The **2022 Energy Code** encourages efficient electric heat pumps, establishes electric-requirements for new homes, expands solar photovoltaic and battery ...

[Workshops, Notices, and...](#) · [2022 Energy Code...](#)

Rulemakings

Final Documents for Title 24, Parts 1 and 6

- Final Express Terms
 - Parts 1 and 6
 - Reference Appendices
 - ACM Approval Manual
- Final Statement of Reasons
- Response to Comments
- Updated Informative Digest
- Nine Point Criteria

Final Documents for Title 24, Parts 2-5 and 11

- Final Express Terms
- Final Statement of Reasons
- Response to Comments
- Updated Informative Digest
- Nine Point Criteria



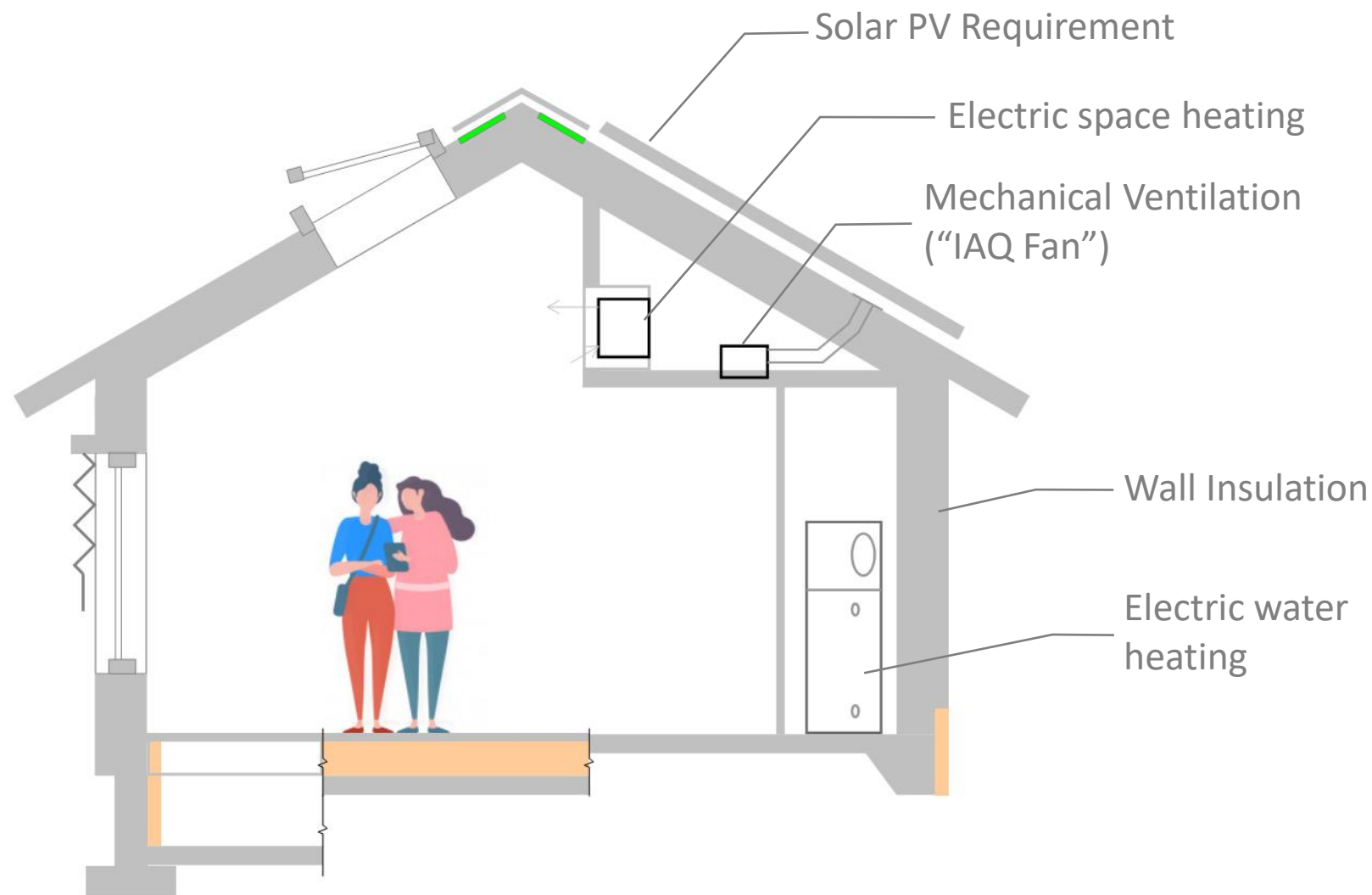
2022 Energy Code—the “How” and “Why”

2022 Code emphasizes **systems**:

- Ease the ADU requirements
- Make homes gas-free

Focus areas:

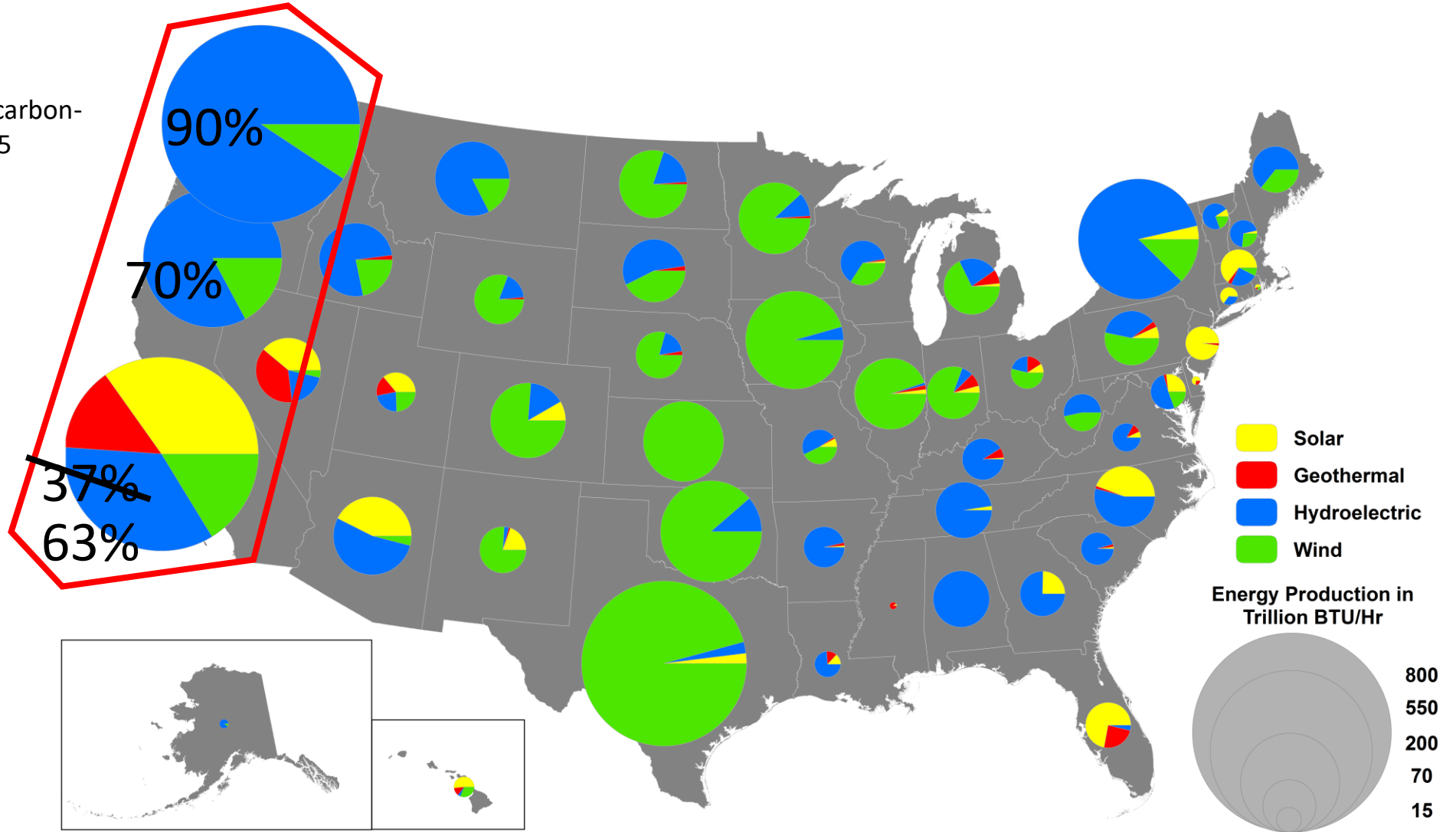
- Solar PV requirement
- Water heating
- Mechanical ventilation
- Space heating
- Battery-ready
- Laundry, cooking



Carbon-Free Electricity Production by State

WA: 100% carbon-free by 2045

CA: 100% carbon-free by 2045



<https://www.npr.org/2022/05/07/1097376890/for-a-brief-moment-calif-fully-powered-itself-with-renewable-energy>

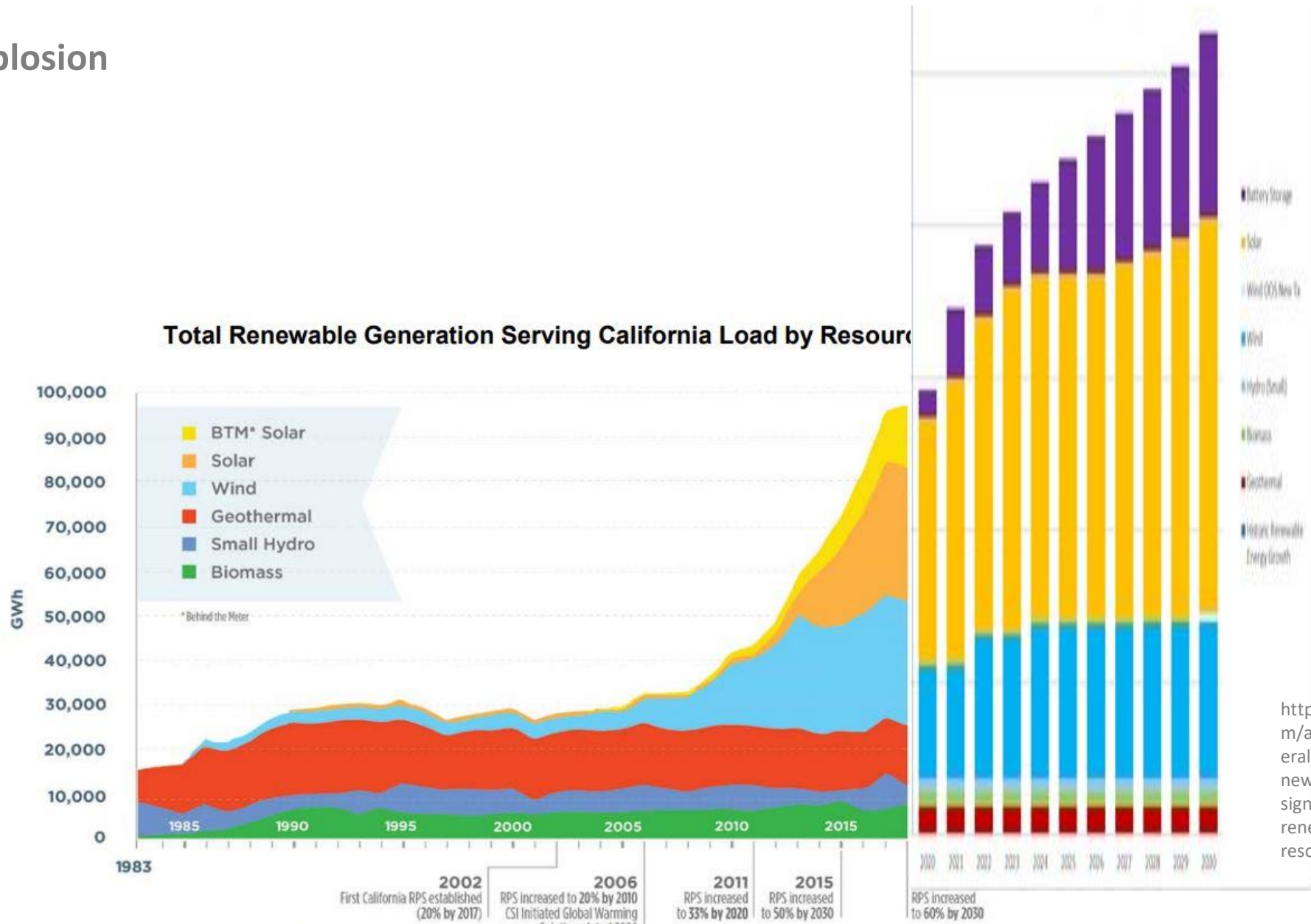
These data were made available by the Energy Information Administration

https://www.reddit.com/r/MapPorn/comments/aapz43/by_state_comparison_of_renewable_resource_energy/

<https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>



Renewables Explosion



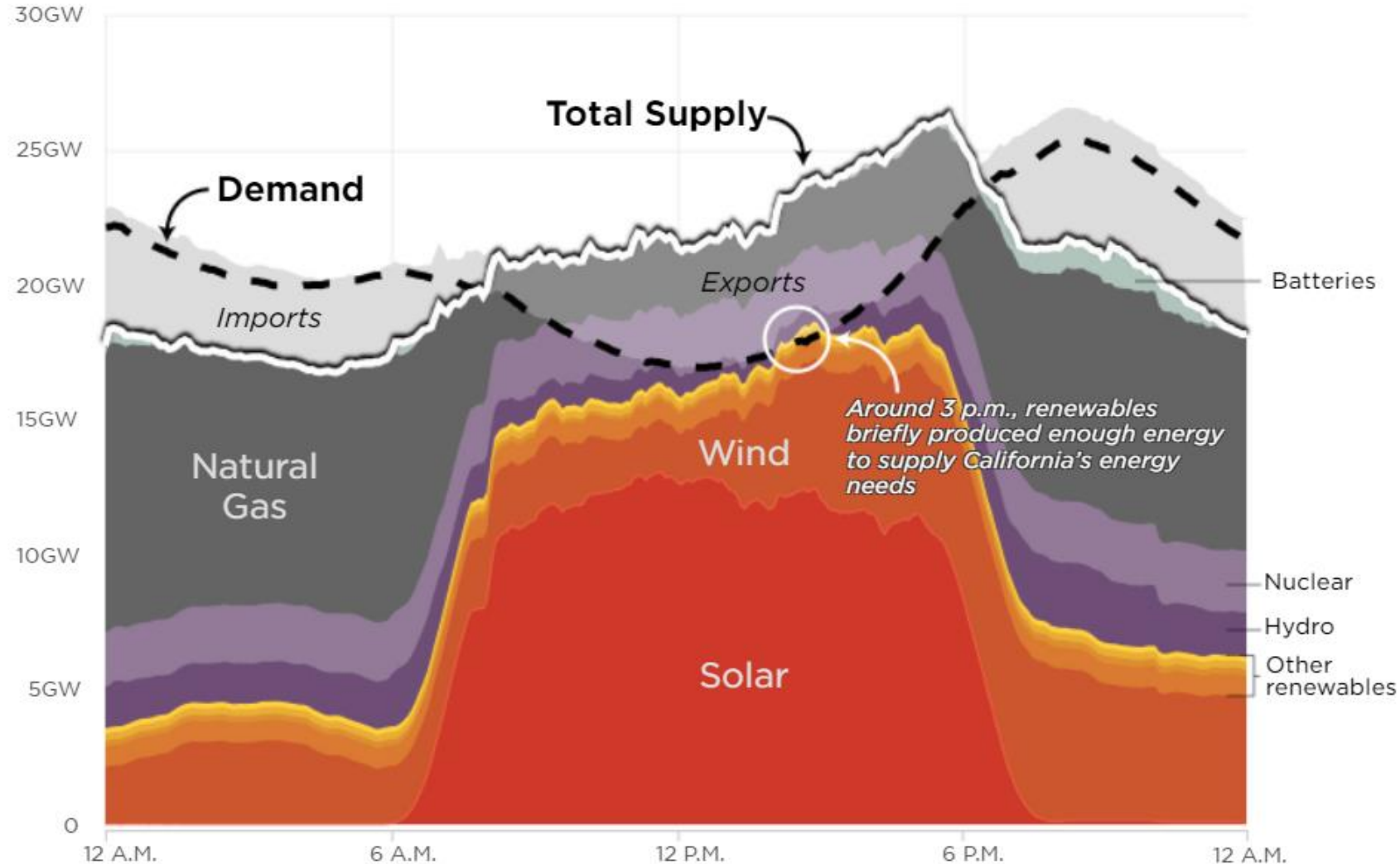
“Conservative Projection”

<https://electricenergyonline.com/article/energy/category/general/90/824636/cpuc-adopts-new-electric-planning-targets-signals-unprecedented-renewable-and-battery-resource-build.html>



Renewable energy breaks record in California

On April 30th, solar, wind and other renewables provided enough electricity to meet the needs within California's Independent System Operator, which supplies about 80% of the state. More power was being generated at the time than was needed, so some was sent to other states.



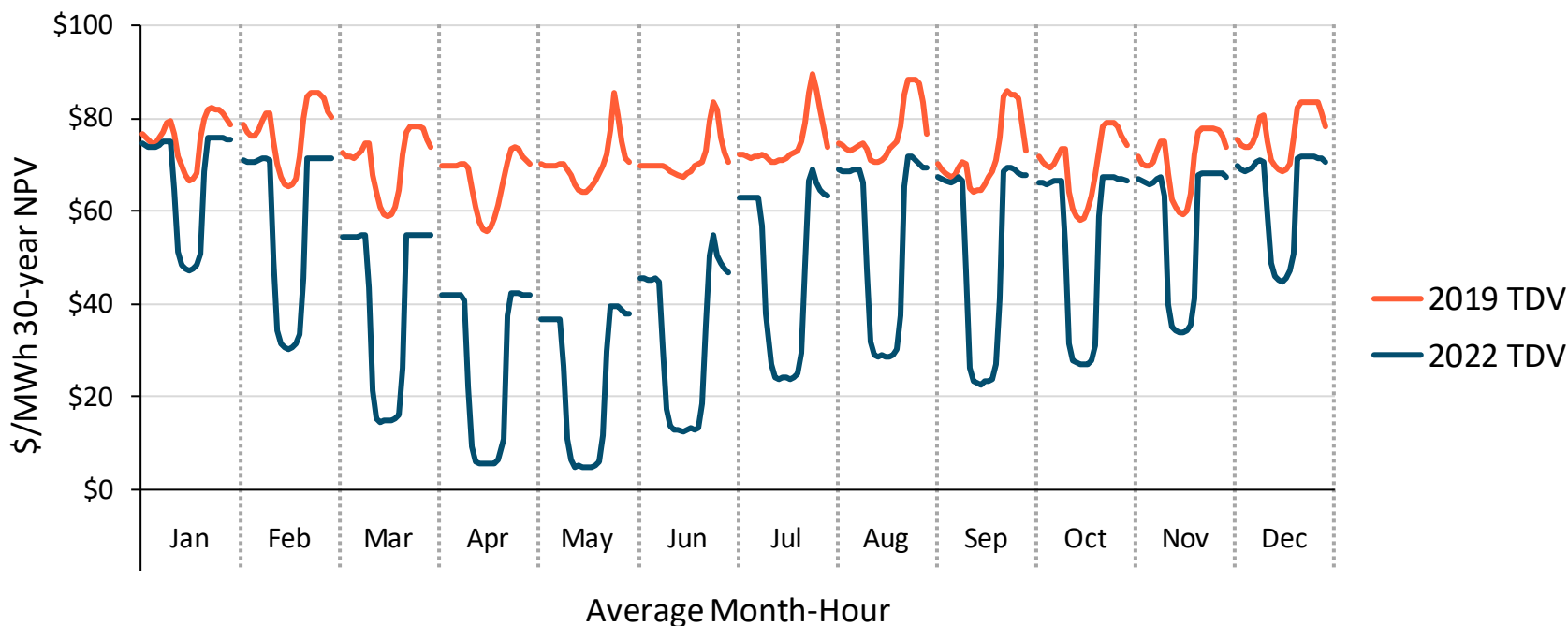
<https://www.npr.org/2022/05/07/1097376890/for-a-brief-moment-calif-fully-powered-itself-with-renewable-energy>

Small Firm Forum – June 9, 2022



Energy Price Shape Comparison

- + Higher buildout of solar in PLEXOS drives down midday prices
- + Abundant near-zero variable cost resources – solar, wind, and storage – contribute to lower prices overall – particularly with Spring’s low loads, high solar, and hydro runoff
- + Storage discharge reduces peak prices in morning and evening “shoulder hours”



New for 2022: PV waived if <1.8 kWdc

Solar PV Size Requirement in kWdc					
New Construction, single detached home					
	Conditioned Floor Area, ft ²				
Climate Zone	250	500	1000	2000	4000
North Bay - 2	1.4	1.5	1.8	2.5	3.7
Cool Bay - 3	1.3	1.4	1.7	2.4	3.6
South Bay - 4	1.4	1.5	1.8	2.4	3.6
Deep East Bay - 12	1.6	1.7	2.0	2.6	3.9



New for 2022: Electric resistance, point-of-use water heater



Conditions:

- New home floor area ≤ 500 sq.ft.
- Point-of-Use = **<10' pipe** to fixture
- “Instantaneous”



“Instantaneous” Tankless

- 50-100 Amps (12-24,000 Watts)
- Energy Factor 0.95



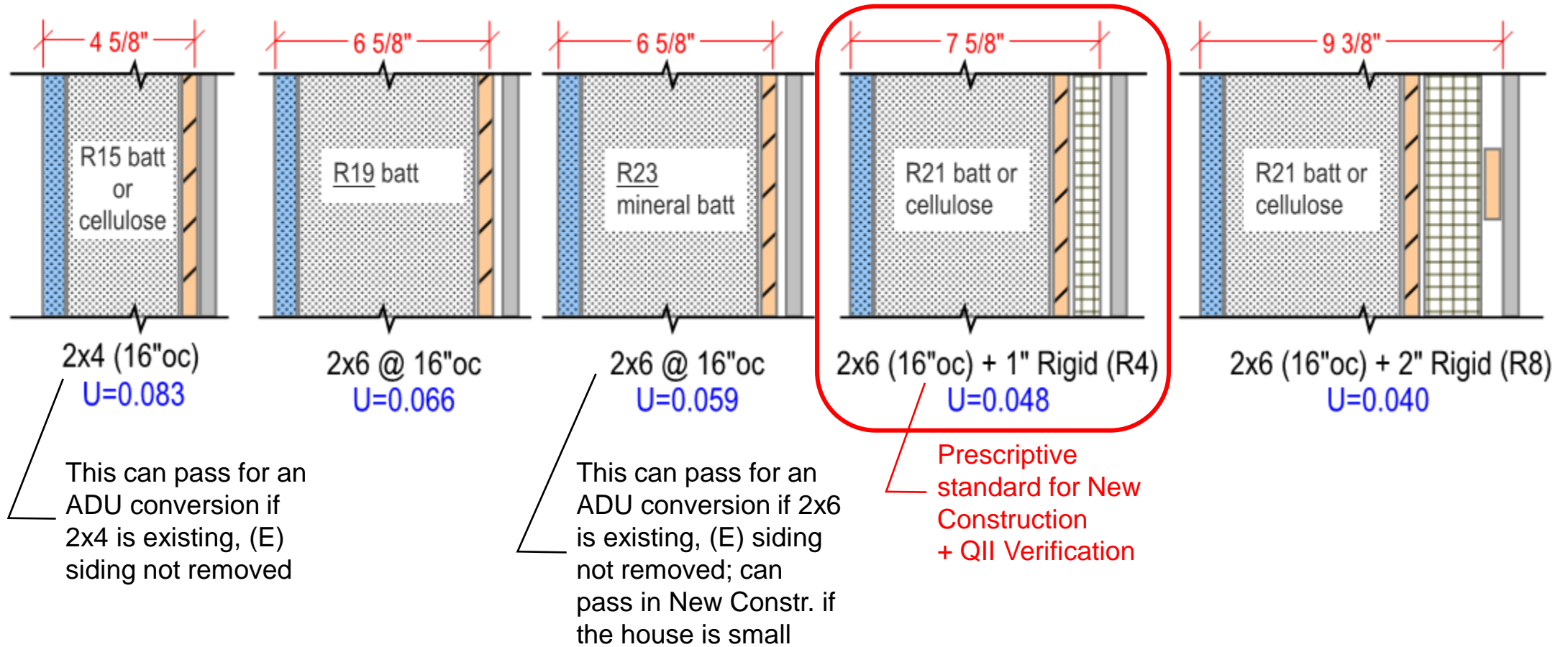
vs. “Low Boy” 30-gal tank under counter

- 25 Amps (6000 Watts)
- Energy Factor 0.89

(heat pumps are 4x more efficient)

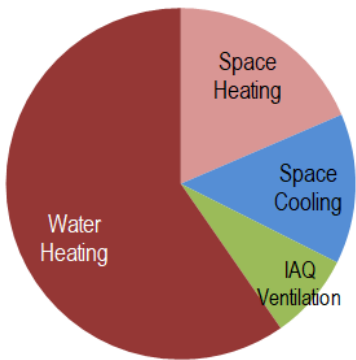
Wall Insulation

Quiz: Which is the 2022 Prescriptive Energy Code wall for new homes in the Bay Area?



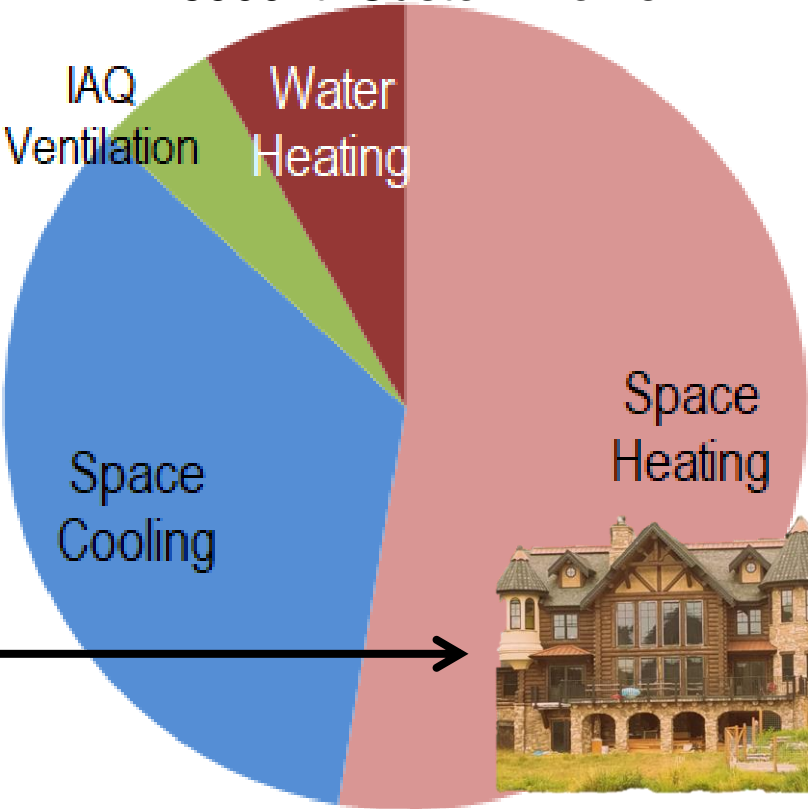
Envelope Insulation

300 ft² Accessory Dwelling Unit



Floor area less than 600 ft² is dominated by *water heating*

6900 ft² Custom Home



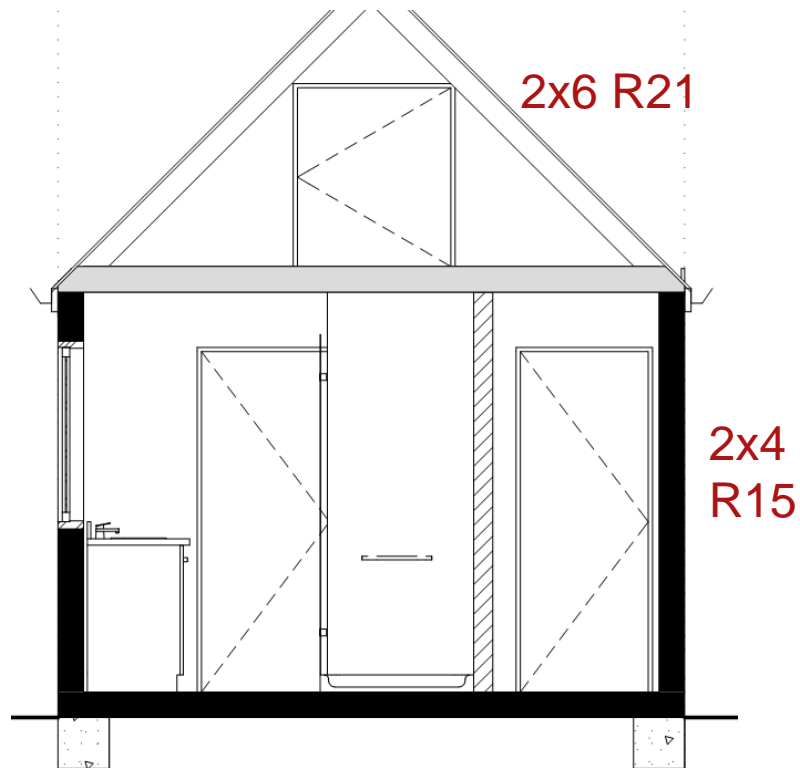
Floor area greater than 1500 ft² is dominated by *space conditioning*

Wall Insulation Examples: Additions

ADU garage conversion, 363 ft².

2x4 R15 walls, 2x6 R21 roof.

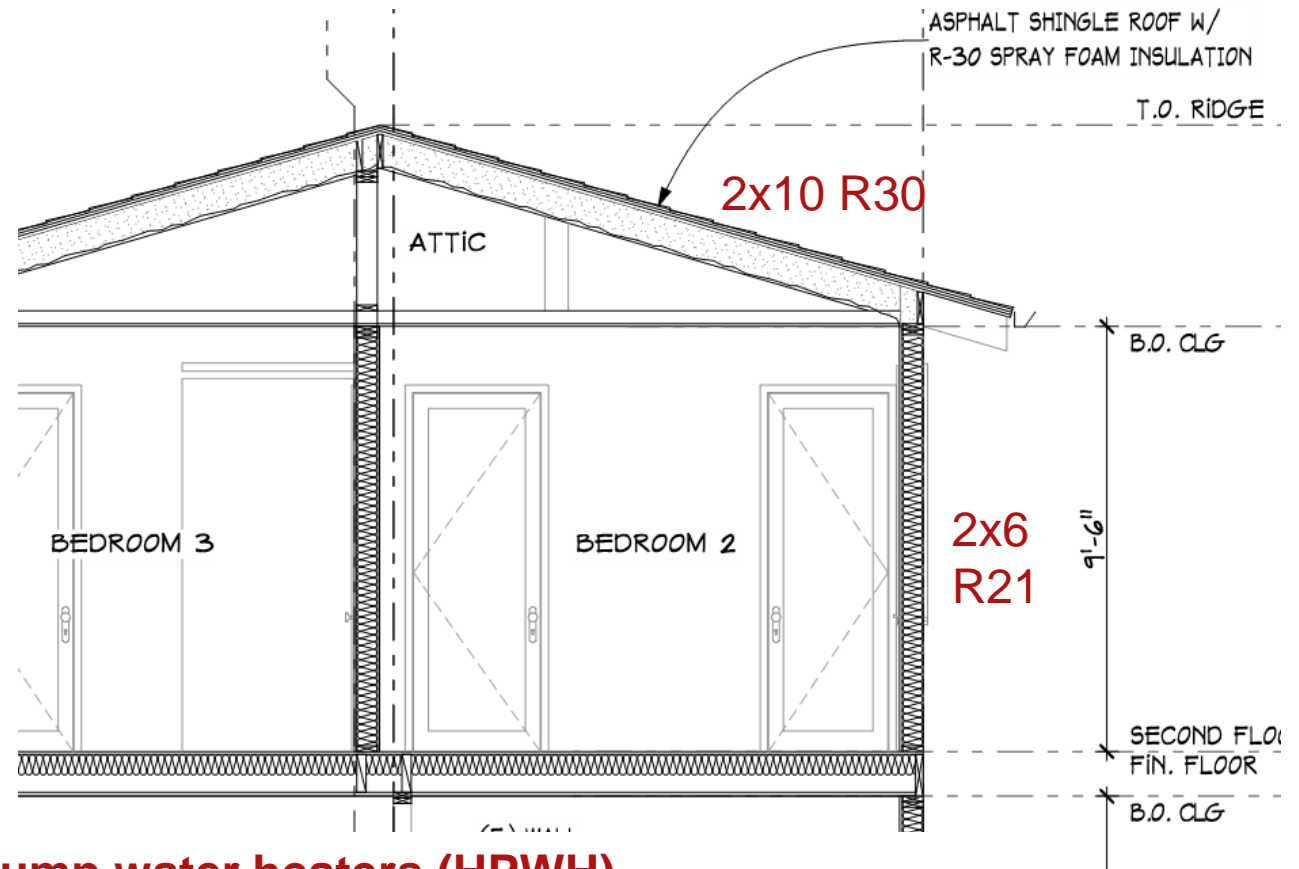
**Exception: existing studs & siding
(couldn't pass with gas hot water)**



Second story addition, 1157 ft².

2x6 R21 walls, 2x10 R30 roof.

(No exceptions available, *barely passing!*)

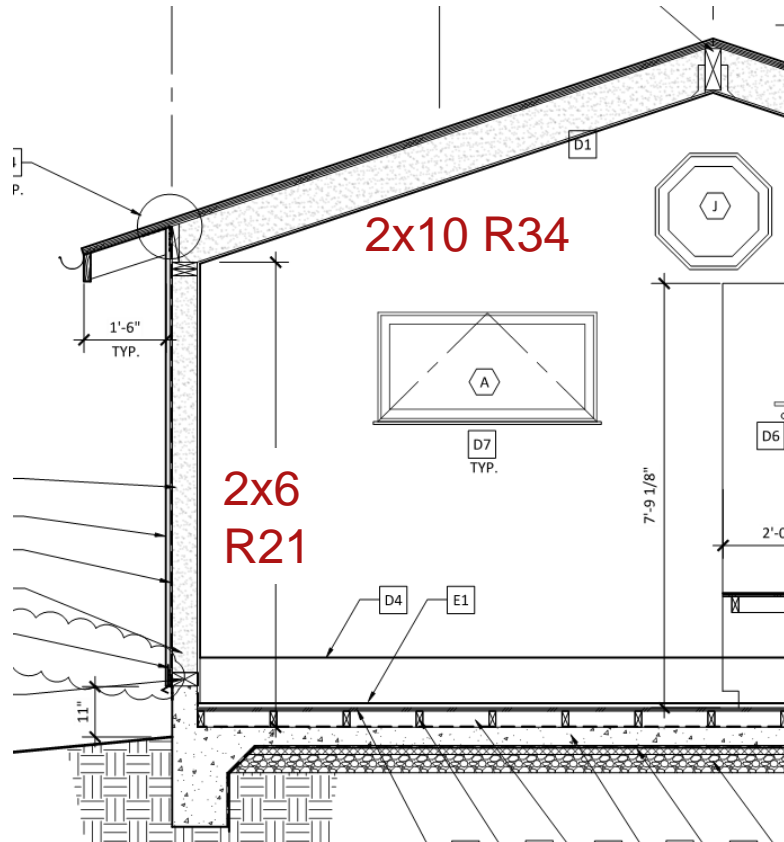


Both use heat pump water heaters (HPWH)

Wall Insulation Examples: New Construction

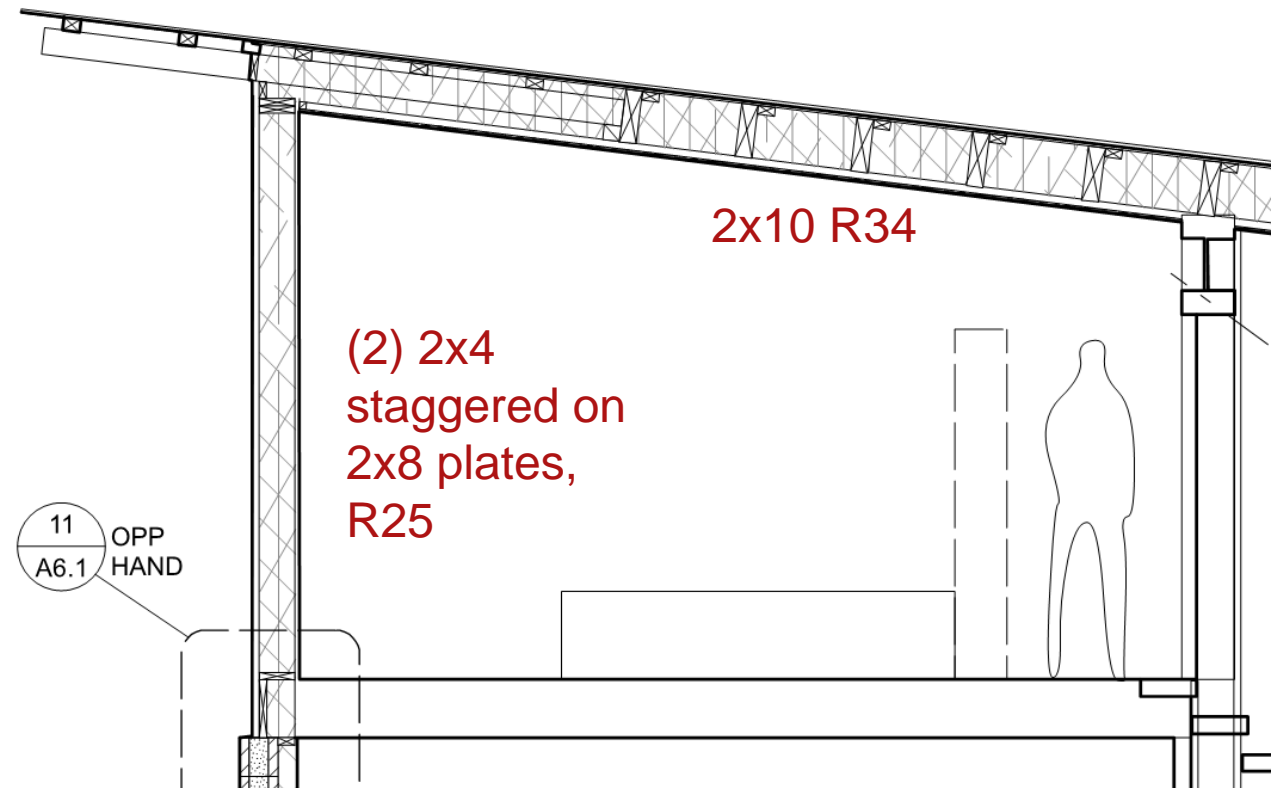
New ADU, backyard site, 560 ft².

2x6 R21 walls, 2x10 R34 roof.



New home, rural site, 2156 ft².

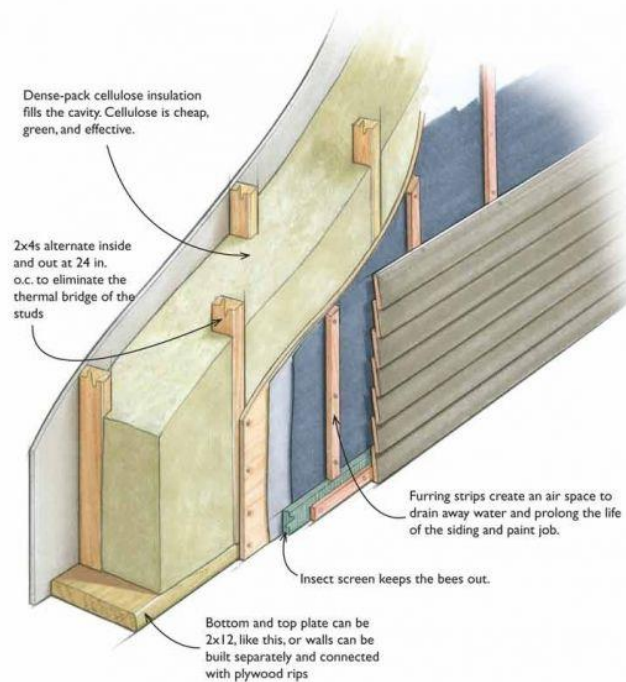
Staggered stud R25 walls, 2x10 R34 roof.



Both use heat pump water heaters (HPWH) and space heating

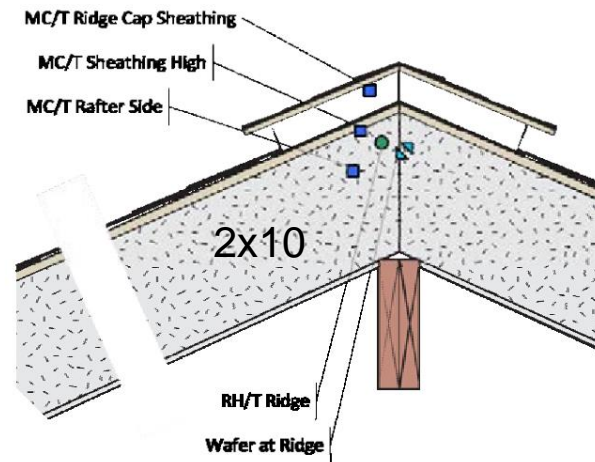
Our 2022 Envelope Work: eliminate foamed plastic, achieve high R-values

Exterior walls Staggered stud 2x4 @ 24"



Roofs

Unvented, dense-pack
cellulose $\geq 2x10$



New unvented options in
2019 Residential Code

Foamed Plastic

- HFCs – climate impact
- Flame retardants
- End-of-life



Natural Rigid Insulation

- Great stuff!
- Expensive = not for every project



1. “Split” Heat Pump

Most flexible option,
\$3000-7000 installed



2. Unitary Heat Pump

Least expensive option,
\$2500-5500 installed

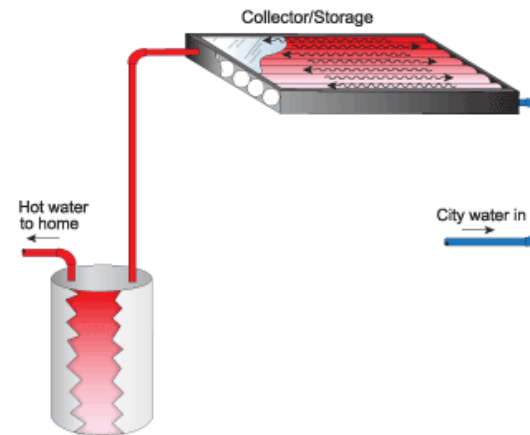
“Retrofit Ready” versions
this year from Rheem and AO
Smith: 120V, less expensive



3. Solar Thermal + Electric Resistance

Smallest option
(least interior
space)

Integral Collector Storage (ICS) System



4. ~~Tankless Electric alone~~



Energy Code penalty cannot be
overcome in performance
calculation

Exception: replacing existing
water heaters *where no gas is
connected*

Water Heating Choices – 2022 Code

1. “Split” Heat Pump

Most flexible option,
\$7000-9000 installed



2. Unitary Heat Pump

Least expensive heat pump,
\$5500-7500 installed

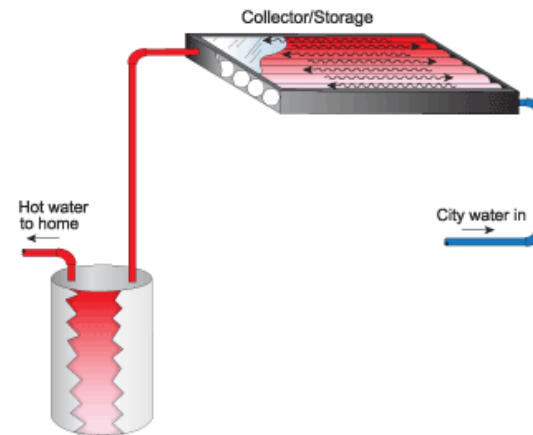
Retrofit Ready versions ~~this year~~
from Rheem and AO Smith: 120V.
New: “1 bedroom or less may use
120-volt HPWH”



3. Solar Thermal + Electric Resistance

Allowed,
but not cost
effective

Integral Collector Storage (ICS) System



4. Electric Resistance alone – it’s back!



Point-of-Use is OK for new
homes & additions ≤500 sq.ft.

Point-of-Use = Less than 10’

BE CAREFUL of AMPS and \$!

Water Heating Comparison

1. “Split” Heat Pump



Most flexible;
no tank venting;
high efficiency;
Low-GWP refrigerant

3.7

Installation
cost*

\$7000-9000

Pollution vs. gas

↓ 90%

2. Unitary Heat Pump



A closet
opening to the
outdoors

3.7 – 4.0

\$5500-7500
(lower for
“retrofit ready”
models?)

↓ 60-80%

3. Electric resistance



“Tiny homes”
≤ 500 sq.ft.
Point-of-use

0.89 tank
0.95 tankless
(more expensive
to operate)

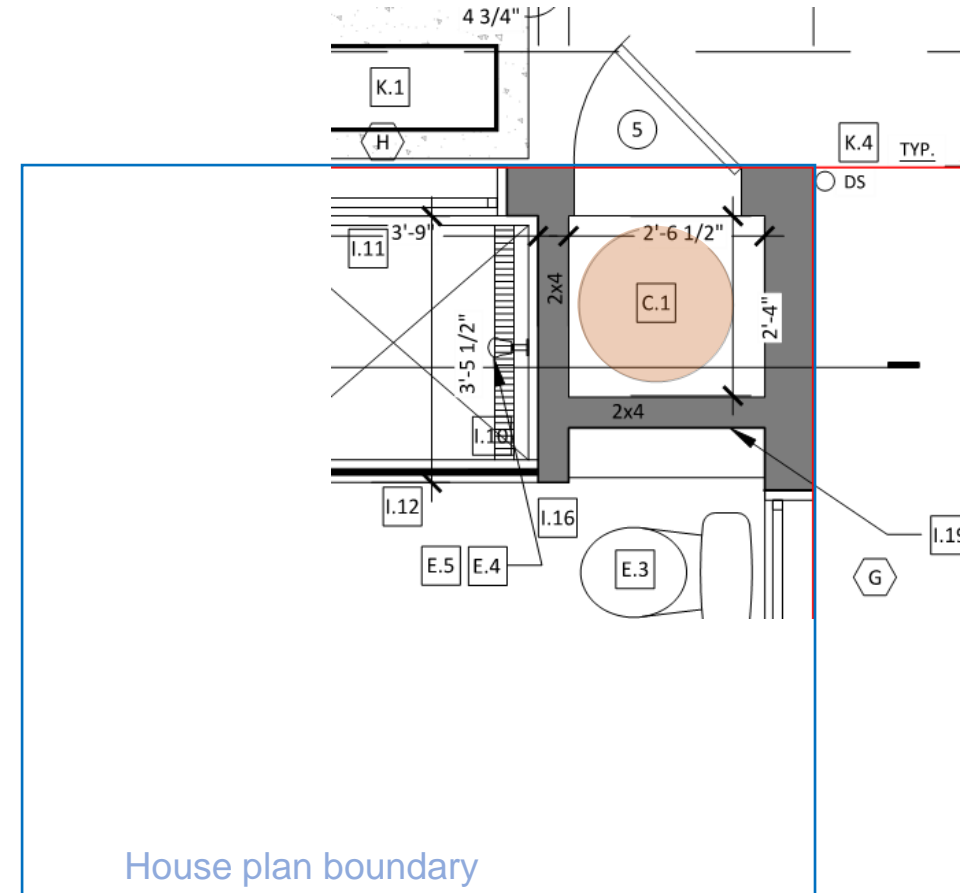
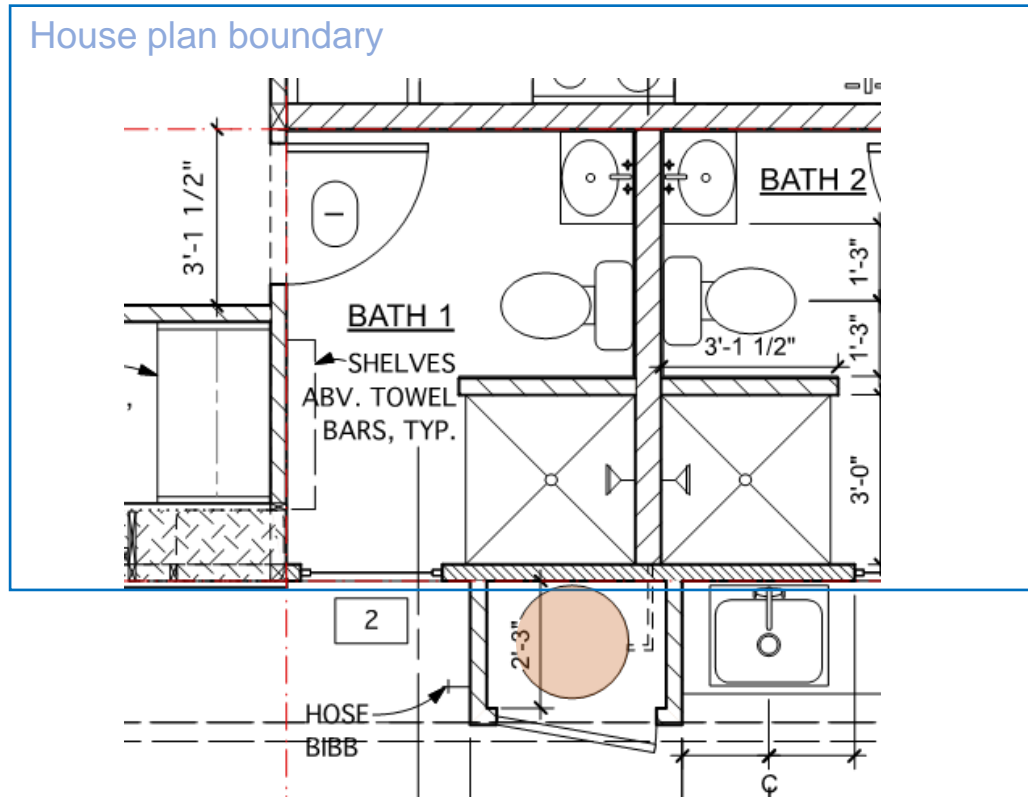
?

↓ 50-80%

*Your results may vary

Small homes & ADUs: provide an “outdoor” closet for storage tank

Collected screenshots showing “outdoor” HPWH tank locations



2022 Ventilation Changes



Range Hoods



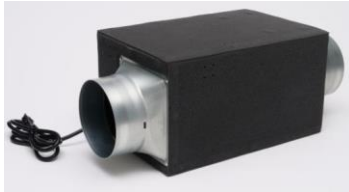

- Must vent to the outdoors (no recirculation)
- Same noise requirements as 2019
- Must be verified by a HERS rater
- **Must be listed for “capture efficiency”**

<https://lacasacultural.tumblr.com/post/13050766333/for-latino-heritage-month-la-casa-hosted/amp>

*Table 150.0-G Kitchen Range Hood Airflow Rates (cfm) and ASTM E3087 Capture Efficiency (CE) Ratings
According to Dwelling Unit Floor Area and Kitchen Range Fuel Type*

<u>Dwelling Unit Floor Area (ft²)</u>	<u>Hood Over Electric Range</u>	<u>Hood Over Natural Gas Range</u>
<u>>1500</u>	<u>50% CE or 110 cfm</u>	<u>70% CE or 180 cfm</u>
<u>>1000 - 1500</u>	<u>50% CE or 110 cfm</u>	<u>80% CE or 250 cfm</u>
<u>750 - 1000</u>	<u>55% CE or 130 cfm</u>	<u>85% CE or 280 cfm</u>
<u><750</u>	<u>65% CE or 160 cfm</u>	<u>85% CE or 280 cfm</u>

Mechanical Ventilation (“IAQ Fan”) Requirement

System type	Exhaust	Source of Fresh Air
Code-minimum		Leaks & Cracks
Better		Supply fan with filter 
Best <ul style="list-style-type: none">• No cold drafts• Compliance credit	Heat-recovery ventilator with filter  ExhaustSupply	

Ventilation Rate Formula

$$\text{Fan Flow } Q = 0.03 \times (\text{Floor Area ft}^2) + 7.5 \times (\# \text{ bedrooms } + 1)$$

Example

$$Q = 0.03 (400) + 7.5 (1+1)$$

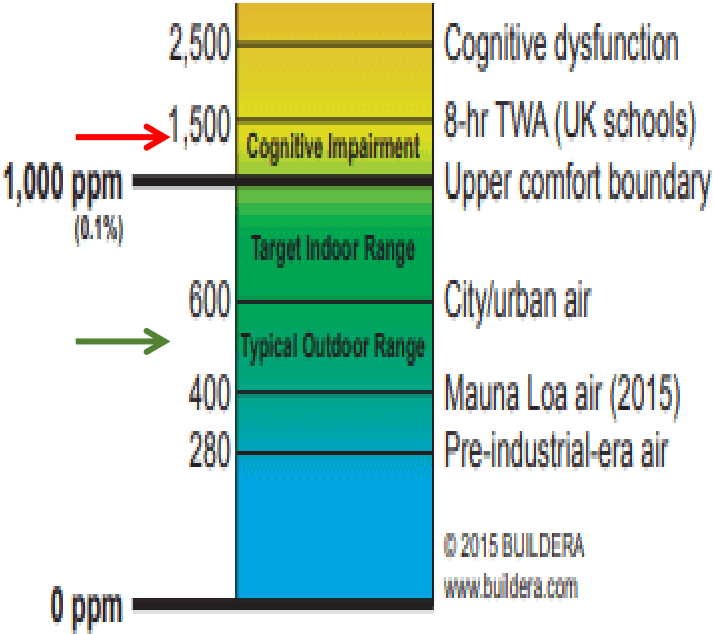
$$Q = 27 \text{ cubic feet per minute (CFM)}$$

30 CFM provided (continuous bath exhaust fan)

“Leaky” Houses Have Poor Indoor Air Quality



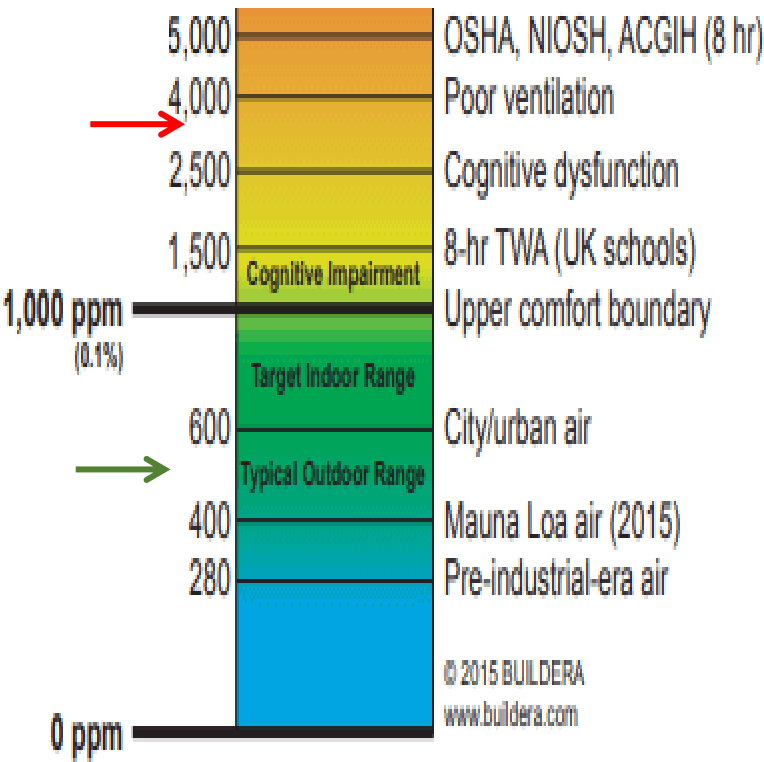
Carbon Dioxide (CO₂) Hazard Scale



“Tight” House With Broken Ventilation



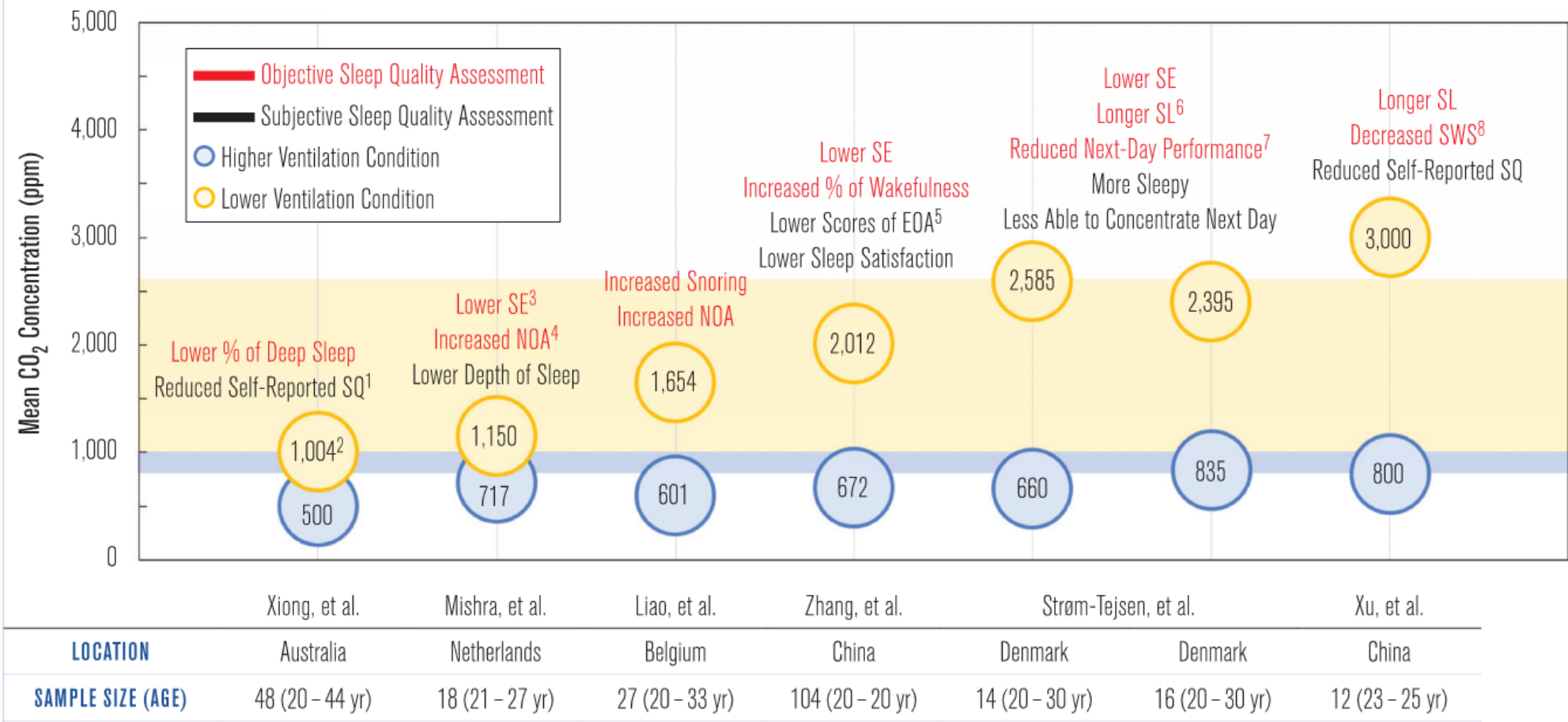
Carbon Dioxide (CO₂) Hazard Scale



Effect of Bedroom CO₂ Level on Sleep Quality

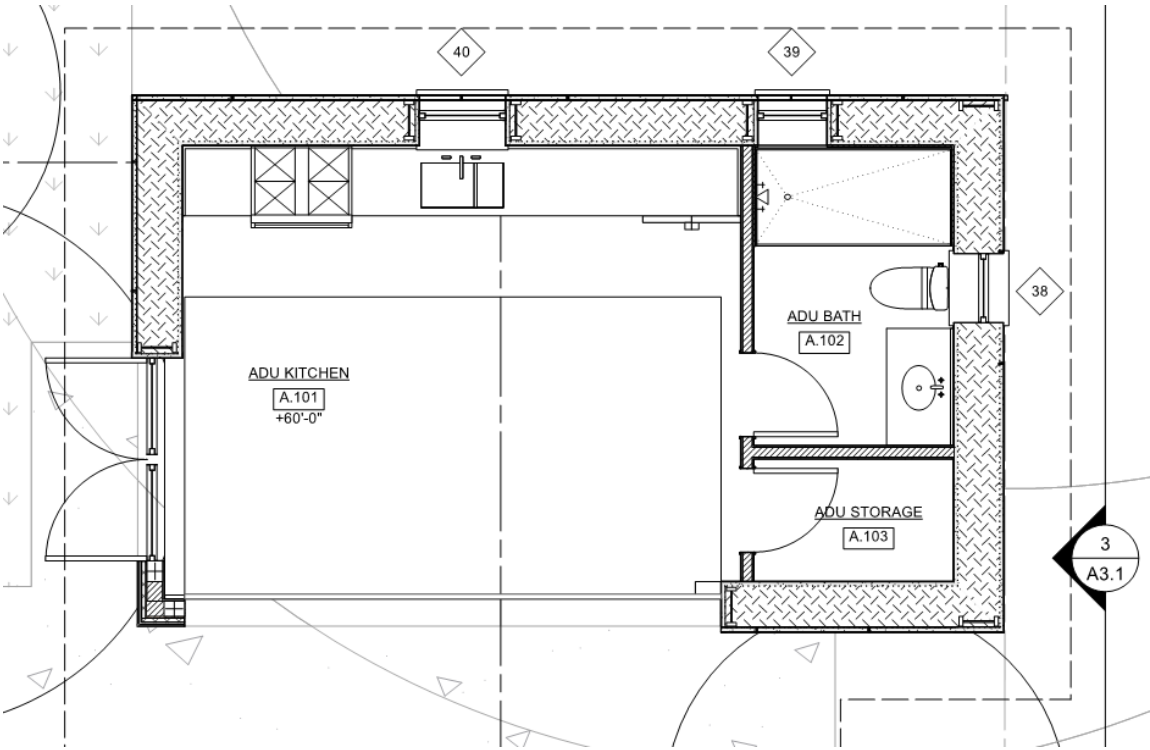


Image Credit: Image #1:
Rileyroxx / Flickr.com



ASHRAE TRP 1837 Reviewing How Bedroom Ventilation Affects IAQ And Sleep Quality

Performance Compliance – Small ADU



- Electric resistance heat, no cooling
- Heat pump water heater (HPWH) loop from main house

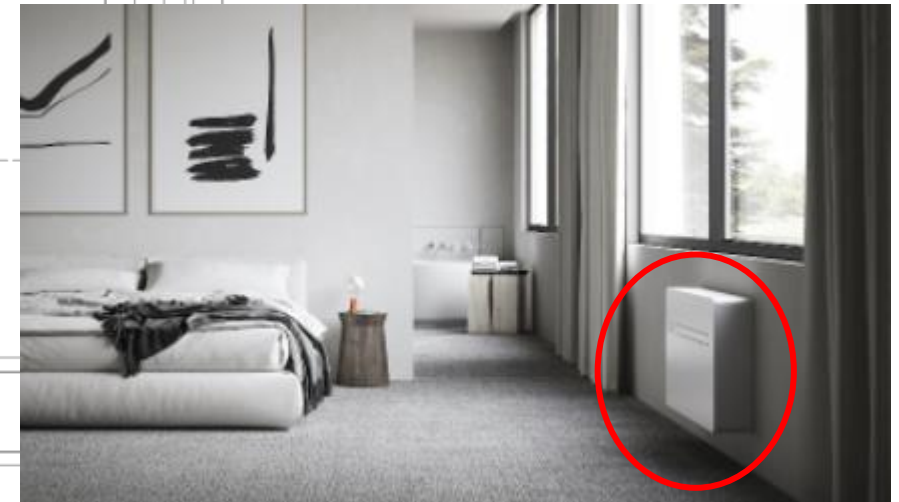
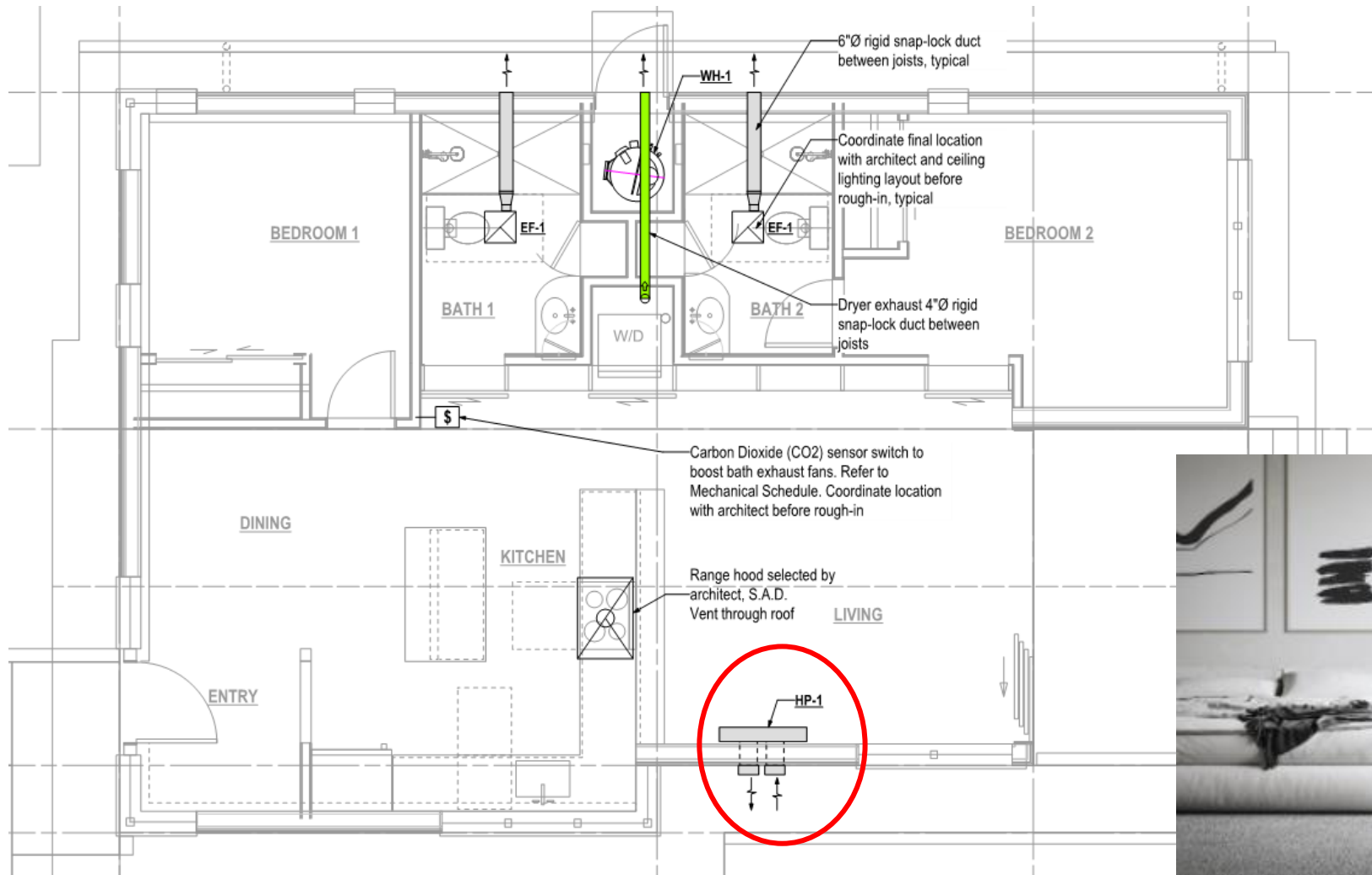
2019

	Energy Design Ratings:	
	Efficiency ¹ (EDR)	Total ² (EDR)
Standard Design	62.3	32.6
Proposed Design	68.1	28.9
	FAIL -10%	PASS

2022

	Energy Design Ratings:		
	Source (EDR1)	Efficiency ¹ (EDR2)	Total ² (EDR2)
Standard Design	33.2	46.0	35.4
Proposed Design	31.3	47.4	29.7
	PASS	FAIL -3%	PASS

Performance Compliance – Larger ADU



- Ephoca (Innova)
- Olympia Splendid Maestro

Small heat pumps

- Ephoca (Innova)

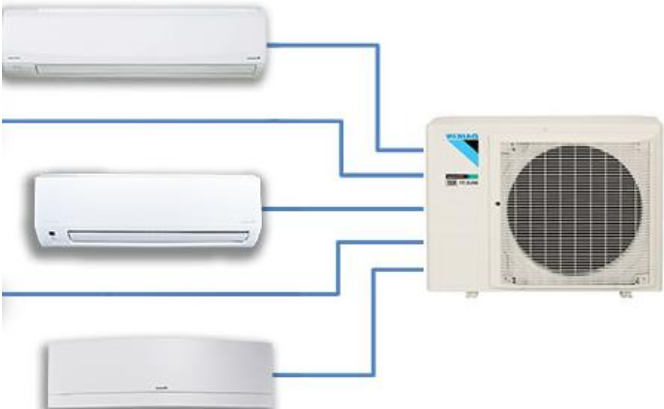


- Olimpia Splendid Maestro



Ductless Mini-splits

<https://www.pinterest.com/danjoh99/ductless-mini-splits/>



Walden Pond Visitor Center



Modern interior design wal...



Grace



Dan Johnson



老城區，新生活：新家入住一週年 的 記錄。 @ 許凱倫 的 ...



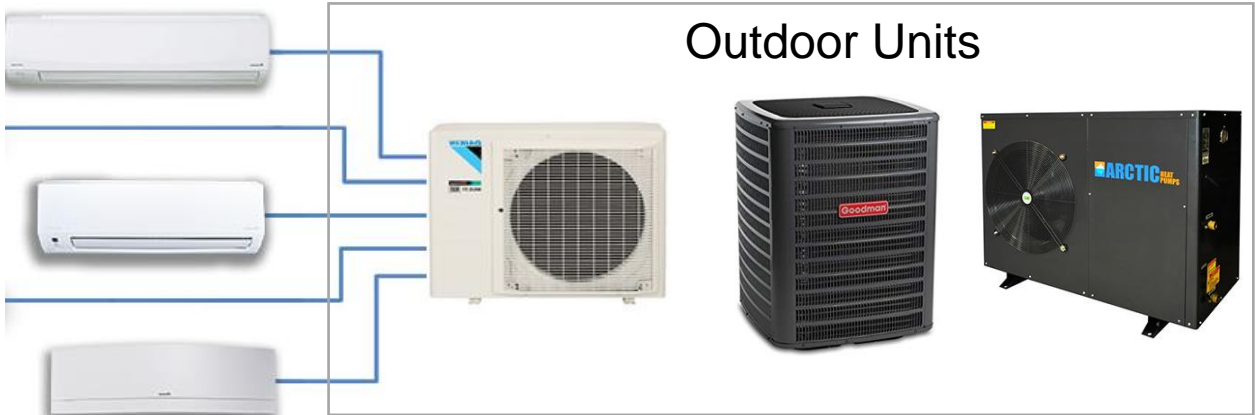
Space Heating Choices: Two paths

A. Heat Pump

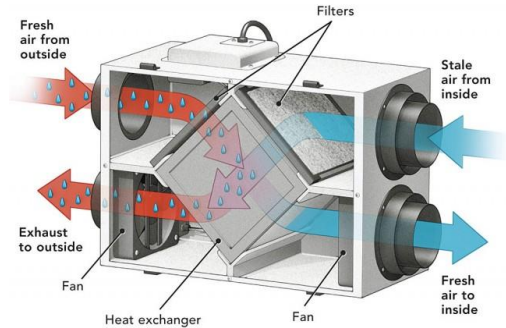
Indoor Units



Outdoor Units



B. 1) Electric resistance + 2) Heat-recovery ventilation + 3) Good insulation



Space Heating: Pro/Con

A. Heat Pump



(Many distribution choices)



Best for homes **>1000 ft²** and/or lots of exposure to outdoors,
Provides A/C

Efficiency

300-400%+

Installation Cost

Roughly the same as gas-fired heat;
large variation in bids
\$\$\$

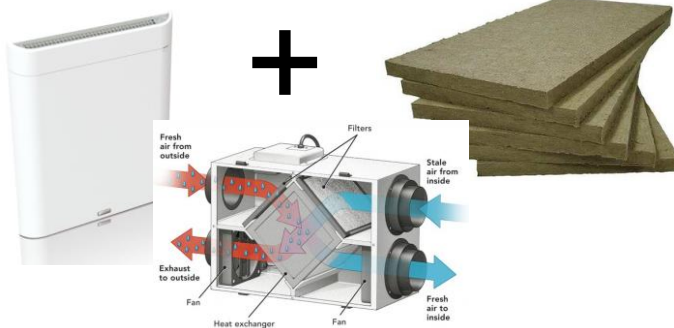
Operating Cost

Roughly the same as gas-fired heat, depending on many factors
\$

Lifecycle cost

\$\$

B. Electric resistance heat + HRV + insulation



Best for homes **<600 ft²** and/or highly insulated
No Cooling

99% Max

Inexpensive to install
\$

3x the running cost of the heat pump
\$\$\$

\$\$

Electric Appliance-Ready §150.0(t, u, v)

Heat pump
clothesdryer



240V, 20A

Induction range



240V, 40A



Provide electric breaker space and
cables running to locations of any
gas appliances*

*Note that replacement gas appliances
won't be sold after 2029-2035

<https://www.thespruce.com/how-to-wire-an-electrical-panel-1152762>

Battery Ready (“ESS”) §150.0(s)



Resources

- Get **layout & pre-planning** requirements from favorite solar installer
- Beware **service clearances** and distances to water pipes, refer to PG&E Greenbook
- **Create a template diagram and notes** for new home plan sets



Guidelines

- **Avoid service upgrades**
- Existing **100A service is enough** to electrify everything, using circuit-sharing devices (refer to Resources)
- Upgraded service will trigger all clearance rules around the panel (PG&E Greenbook)
- Assume that an **ADU needs a new service** & separate meter

Resources

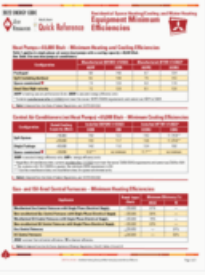
- Redwood Energy Guides

<https://energycodeace.com>




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Fact Sheet: What's Changed
for 2022 – Multifamily
Buildings



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Energy Code & Regs

2022 En... & 3 more ▼

<http://redwoodenergy.net/research/>

Home About Us Development Projects **Make Use of our Extensive Research!** Blog Installation


Zero Carbon Retreat is January 27-28, 2022!

Redwood Energy


Foremost Zero Net Energy Specialists in Multifamily Housing

Make Use of our Extensive Research!


Zero Emissions All Electric Construction Guide Series




Zero Emissions All Electric Multifamily Construction




Zero Carbon Commercial Construction Guide 2nd Edition



Zero Emissions All Electric Single Family Construction



Pocket Guide to Single Family Electric Retrofits



Consumers Energy All-Electric Multifamily Design Guide October 2021

<https://redwoodenergy.net/wp-content/uploads/2021/02/Pocket-Guide-to-All-Electric-Retrofits-of-Single-Family-Homes.pdf>

All Electric 100 Amp Home (2,000 square feet)					
Ducted heat pump, medium power heat pump water heater, hybrid heat pump dryer					
Device Volts	Device Amps	100 Amp Panel		Device Amps	Device Volts
120	12	Lights/Plug 15	15	Lights/Plug 12	120
120	12	Lights/Plug 15	15	Lights/Plug 12	120
120	14	Lights/Plug 20	20	Lights/Plug 14	120
120	10	Garbage Disposal 20	20	Kitchen Outlets 15	120
120	7	Refrigerator 20	20	Kitchen Outlets 15	120
240	3	Forced Air Unit 15	15	Dishwasher 12	120
				Clothes Washer 15	120
240	20	Heat Pump HVAC 30	30	Hybrid Heat Pump Dryer 14	240
240	20	EV Charger 25	25	Range (cooktop + oven) 40	240
240	16	Solar Input 20	20	Heat Pump Water Heater 12	240
House square footage = 2000		Total Counted Panel Amps = 96.6			

<https://sunroof.withgoogle.com>



How Project Sunroof Works

Your own personalized solar savings estimator, powered by Google Earth imagery.



1

Search for your home

We use Google Earth imagery to analyze your roof shape and local weather patterns to create a personalized solar plan.

Gas-Free Mandates for New Construction



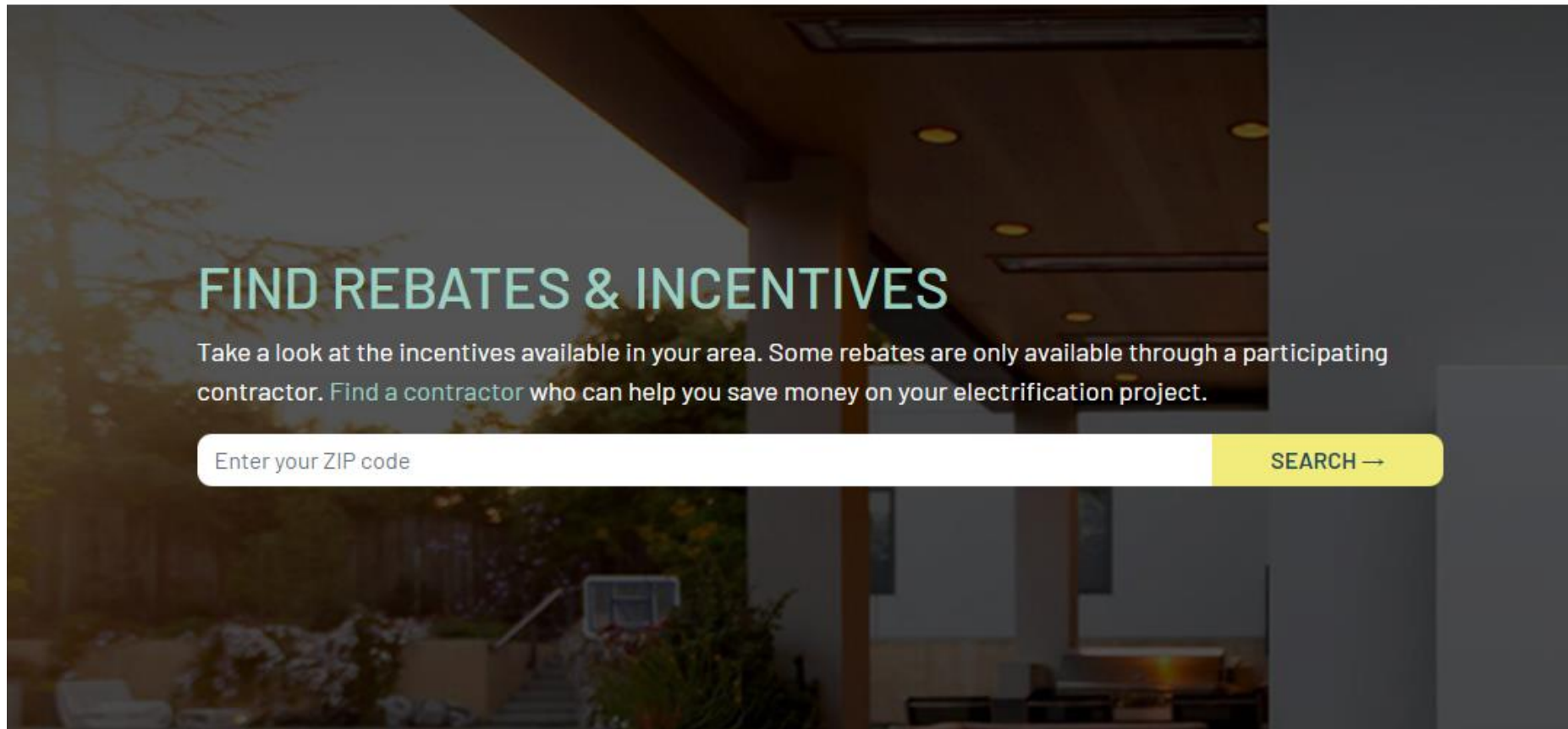
<https://localenergycodes.com/>

Statewide Reach Codes Program



The screenshot shows the homepage of the localenergycodes.com website. At the top, there is a navigation bar with three links: "WHAT IS A REACH CODE?", "WHY ADOPT REACH CODES", and "WHERE IN CA HAVE REACH CODES BEEN ADOPTED?". The third link is circled in red, and a red arrow points to it from the right. Below the navigation bar, the main heading is "5 PATHS TO REACH BEYOND". Under this heading, there are five vertical cards, each with a title, a list of topics, and a small icon at the bottom.

BUILDING EFFICIENCY/ RENEWABLES	ELECTRIC READY	ENERGY PLUS WATER	INFORMATION DISCLOSURE	PROCESS LOADS
Whole Building Equipment-Specific	Pre-Wiring Panel Upgrade EV-Readiness EV Charging	Dual Plumbing Onsite Water Reuse Water Neutral Development	Audits Benchmarking	Commercial Kitchens Elevators Escalators Controlled Environment Horticulture



Search for Rebates

CALIFORNIA AIR RESOURCES BOARD (CARB)

AB 32 Climate Change Scoping Plan

The [2022 Scoping Plan](#) Update will lay out a path to achieve carbon neutrality by 2045.

CARB released their [Draft Scoping Plan Update](#) on May 10. The specific chapter on building decarbonization can be [accessed here](#). The draft establishes three main goals for buildings:

- Energy efficiency aligned with the mid-high (electric) and mid-mid (gas) scenarios from the 2019 Integrated Energy Policy Report
- New construction would be zero-emission starting in 2026 for residential buildings and 2029 for commercial buildings through alignment of state and local authorities
- **By 2035, all new appliances sold in California would be zero-emission**

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

BAAQMD to Mandate All-Electric Furnaces and Water Heaters

Management District (“BAAQMD”) rules (Rule 9-4 and Rule 9-6) govern the sale and installation of new residential and commercial furnaces and water heaters.

The amendments would require zero-NOx emission appliances. **Meaning that after the compliance deadlines, all new furnaces and water heaters subject to the rule must be electric.**

By January 1, 2029, all new furnaces sold or installed in the BAAQMD must meet the zero-NOx standard.

