Early EHDD Zero Energy Buildings


IDeAs Z² Office, 2006


Audubon Center, 2001


Packard Foundation, 2010

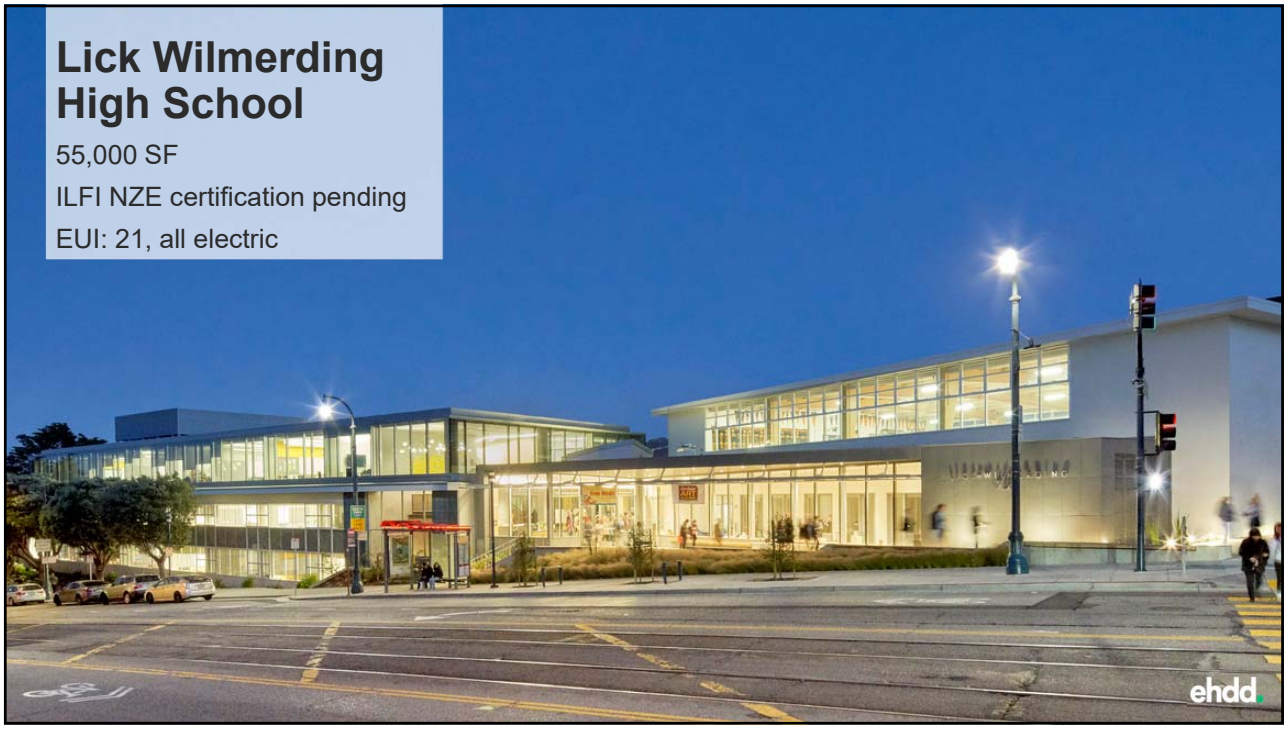

Exploratorium, 2011

ehdd


Mark Day School
15,000 SF
ILFI NZE certification pending
EUI: 29, all electric
ehdd


PV cost
$165,000
1.7% of construction cost
PPA is lower cost than Utility

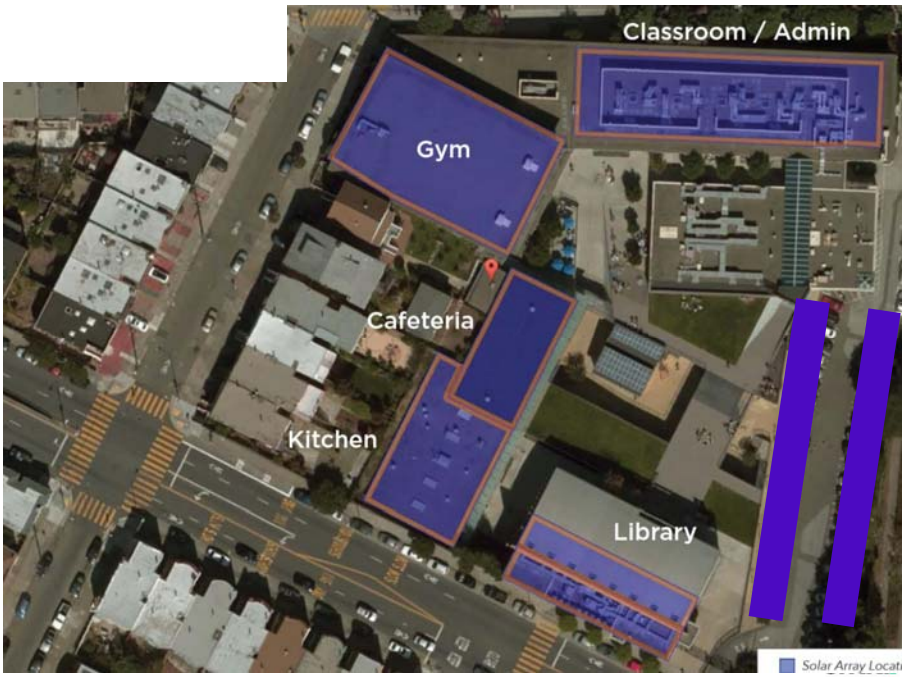

Include PV in project!
Let your team do the work!
It's just part of MEP system


Lick Wilmerding High School
55,000 SF
ILFI NZE certification pending
EUI: 21, all electric
ehdd


LICK-WILMERDING
755

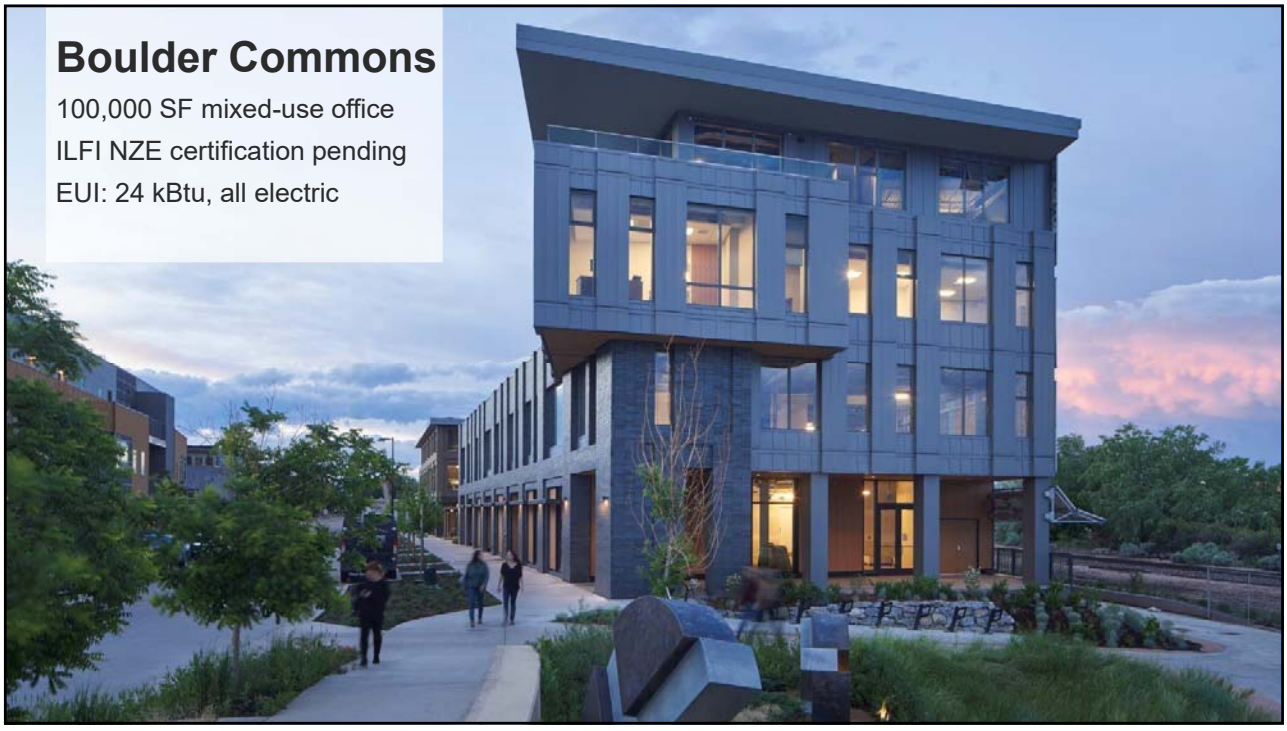
Replace Existing Gas Boilers with Heat Pumps

Plan future electrification & Campus PV location



Boulder Commons

100,000 SF mixed-use office
ILFI NZE certification pending
EUI: 24 kBtu, all electric



What does a Developer Want? What's in it for them……?

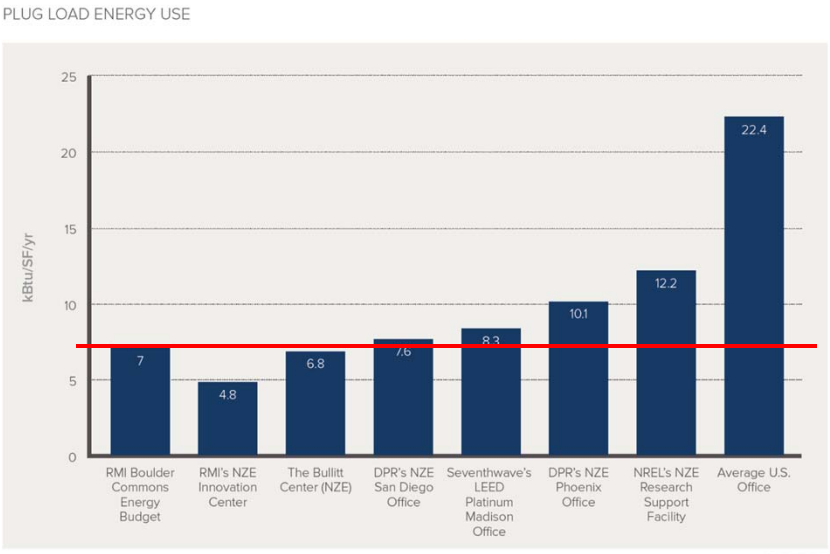
- Lease Rates/Sales Price that create a return on invested capital (8-10%)
- Predictability with regard to operating costs and tenants
- Long-term operating costs lower than competitors
- Long-term Value (high occupancy, appreciation, etc.)

ehdd.

Plug Load Budget – 7 kBtu/SF/YR

- Printer/copier energy save mode
- Laptops
- Energy star appliances
- 1 monitor/person

- Monitoring, continuous reporting
- Power strips w/ timer or occupancy sensors
- Monitor big loads independently

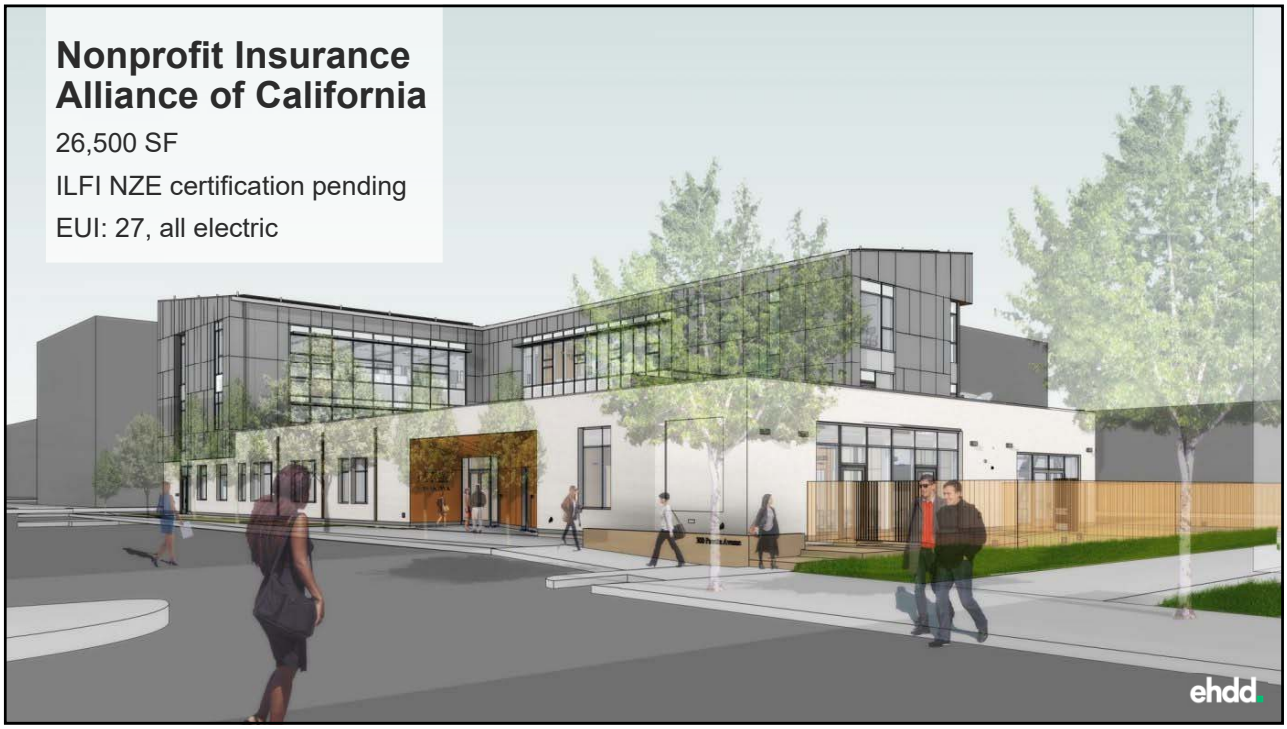


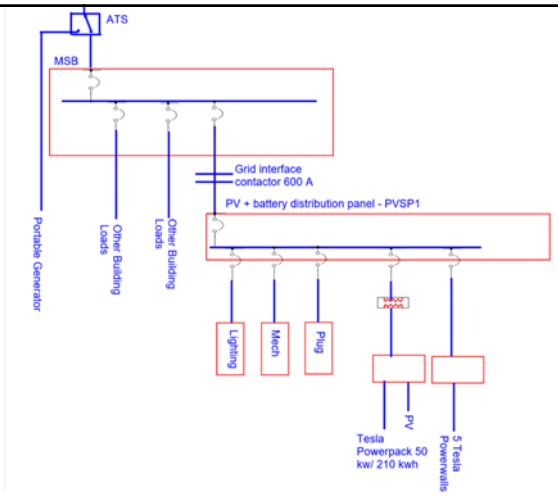
Nonprofit Insurance Alliance of California

26,500 SF

ILFI NZE certification pending

EUI: 27, all electric

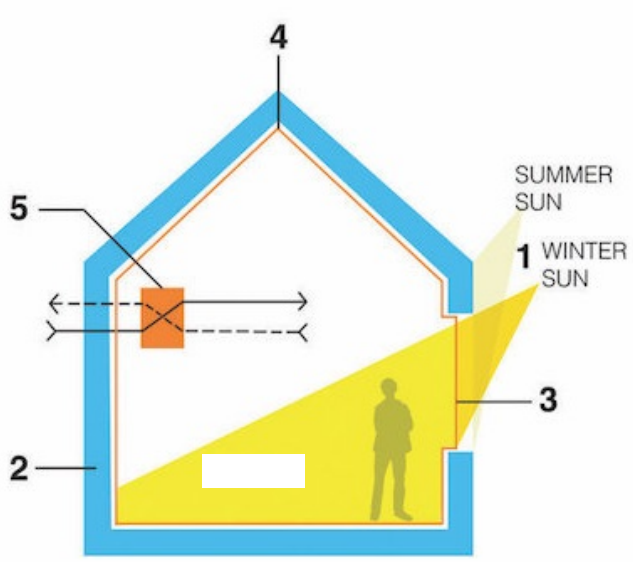




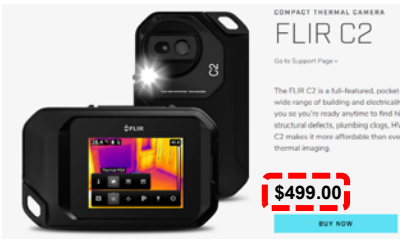
Time Duration	2-hr window	4-hr window	8-hr window	12-hr window	1 day	2 day	3 day	4 day	5 day
Scenario 1 - Battery Size	37 kWh	73 kWh	142 kWh	200 kWh	288 kWh	475 kWh	691 kWh	921 kWh	1152 kWh
Scenario 1 - Cost	$ 29,900	$ 51,900	$ 94,200	$ 129,300	$ 183,200	$ 297,600	$ 429,800	$ 570,700	$ 711,600
Scenario 2 - Battery Size	38 kWh	75 kWh	146 kWh	204 kWh	295 kWh	489 kWh	712 kWh	950 kWh	1187 kWh
Scenario 2 - Cost	$ 30,300	$ 52,900	$ 96,200	$ 131,900	$ 187,600	$ 306,200	$ 442,800	$ 588,000	$ 733,300
Energy Model - Battery Size	230 kWh	448 kWh	562 kWh	792 kWh	901 kWh	1606 kWh	2344 kWh	2794 kWh	3059 kWh
Energy Model - Cost	$ 147,600	$ 281,400	$ 350,600	$ 491,600	$ 558,000	$ 989,700	$1,441,400	$1,716,600	$1,878,500
Scenario 4 - Battery Size	83 kWh	143 kWh	172 kWh	215 kWh	292 kWh	479 kWh	591 kWh	591 kWh	591 kWh
Scenario 4 - Cost	$ 57,900	$ 94,600	$ 112,500	$ 138,300	$ 185,800	$ 300,200	$ 368,400	$ 368,400	$ 368,400
Scenario 4b - Battery Size	104 kWh	184 kWh	254 kWh						
Scenario 4b - Cost	$ 70,400	$ 119,600	$ 162,600						

Passive House

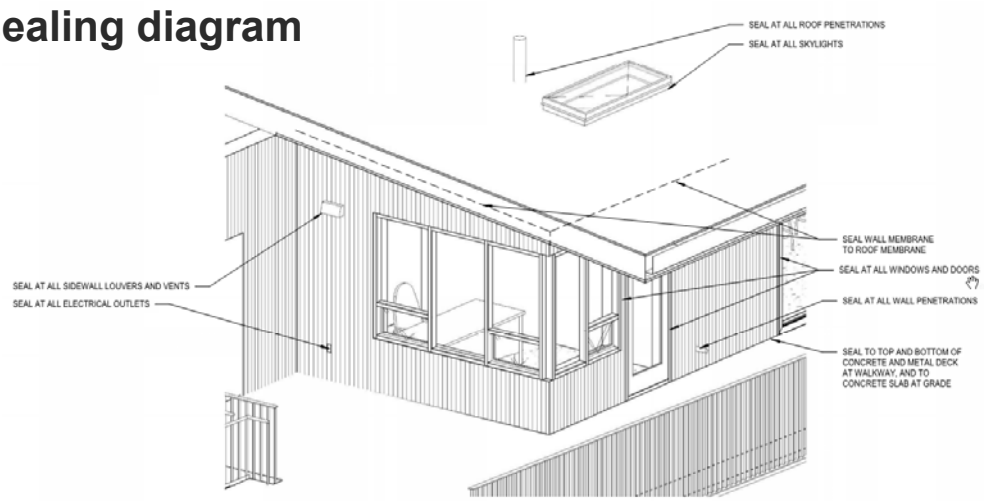
1. Excellent insulation
2. Reduce thermal bridges
3. Air-tight Enclosure
4. High Performance windows
5. Heat Recovery Ventilation



Thermal Bridging



Air-sealing diagram



AIR-SEALING REQUIREMENTS:

1. THE PROJECT SHALL HAVE A CONTINUOUS AIR-BARRIER AT THE BUILDING ENVELOPE, FROM FOUNDATION TO WALLS TO ROOF.
2. THE SELF-ADHERING SHEET MEMBRANE AIR BARRIER AT THE WALLS AND ROOFING UNDERLAYMENT AT THE ROOF ARE THE PRIMARY AIR BARRIERS.
3. ALL JOINTS AND INTERSECTIONS SHALL BE SEALED, INCLUDING SLAB TO WALL, WALL TO WALKWAY, WINDOWS, AND DOORS, AND WALL TO ROOF.
4. ALL AIR-BARRIER PENETRATIONS SHALL BE SEALED, INCLUDING PIPING, CONDUIT, WIRING, AND ARCHITECTURAL AND STRUCTURAL PENETRATIONS.
5. CONTRACTOR TO CONDUCT A BLOWER-DOOR AIR-TIGHTNESS TEST TO ASSESS AIRTIGHTNESS PERFORMANCE.
6. BLOWER-DOOR TEST SHALL BE COORDINATED WITH ARCHITECT AND OWNER FOR OBSERVATION.
7. ARCHITECT WILL USE A PORTABLE FOG MACHINE TO IDENTIFY IF THERE ARE SIGNIFICANT LEAKS.
8. A SPECIFIC AIR-TIGHTNESS STANDARD IS NOT SPECIFIED ON THIS PROJECT.

NOTE: THIS IS A DIAGRAM OF POSSIBLE OPENINGS, AND MAY NOT REPRESENT THE ACTUAL LOCATIONS OF THE ELEMENTS REPRESENTED.

ehdd.

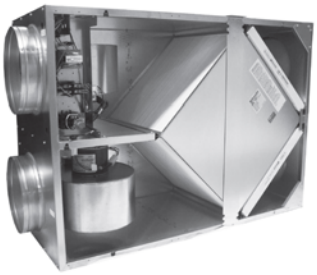
Energy Recovery Ventilator

- 65% reduction in heating load (ventilation)
- We can use smaller heat pumps
  - *Used on all my projects in past 3 years*
- 1-2 code cycles until they are mandatory

HE 1XINH

Energy Recovery Ventilator
Standard & Bypass Economizer

INDOOR UNIT



Download specification at:
renewaire.com/specifications

SPECIFICATIONS

Ventilation Type:
Static plate, heat and humidity transfer

Typical Airflow Range: 250-925 CFM

AHRI 1060 Certified Core: One L125-G5

Standard Features:
Non-fused disconnect
24 VAC transformer/relay package

Filters:
Total qty. 2, MERV 8: 20" x 20" x 2"

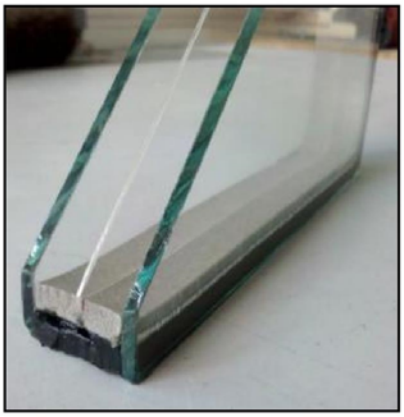
Unit Dimensions & Weight:
54 3/4" L x 23 3/4" W x 35 3/4" H
204-275 lbs., varies by option(s)

Max. Shipping Dimensions & Weight (on pallet):
63" L x 30" W x 56" H
325 lbs.
Accessories box shipped loose on top of unit.

Motor(s):
Qty. 2, 0.75 HP ea., Direct drive blower/standard

Thin Triple Glazing

Lawrence Berkeley Labs Andersen Windows



Thin-glass triple IGU

https://windows.lbl.gov/triple-glazing-thin-non-structural-center-glass

Drop-in replacement

High **performance**

Minimal weight

Single spacer

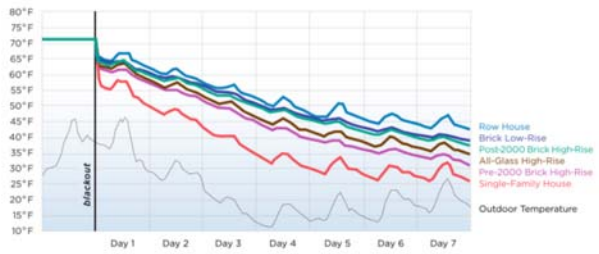
Same **width** as double

Low entry **cost**

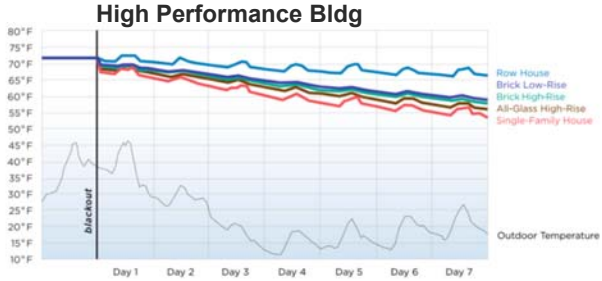
ehdd.

Indoor Temps During Winter Blackout

Standard Performance Bldg

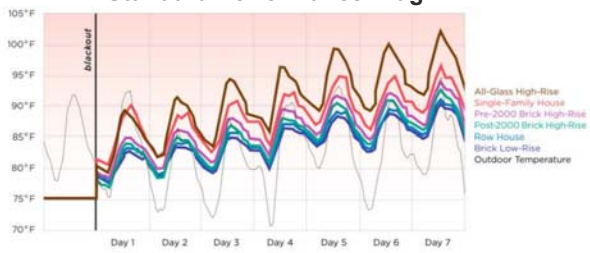


High Performance Bldg

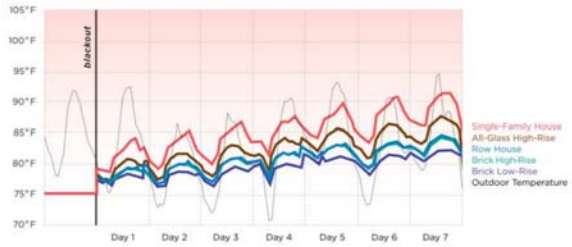


Indoor Temps During Summer Blackout

Standard Performance Bldg



High Performance Bldg

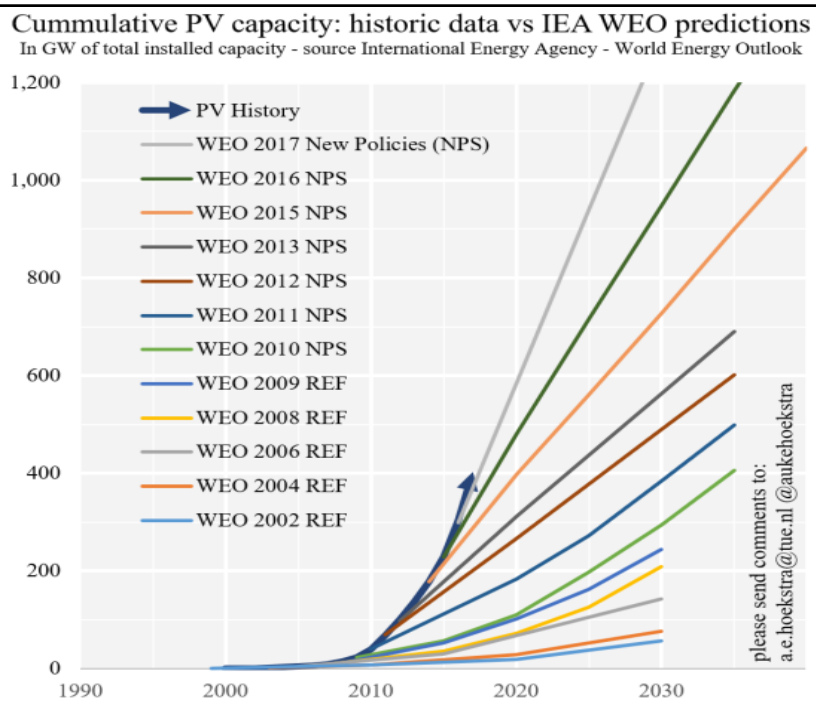


NOT Zero Energy Buildings…

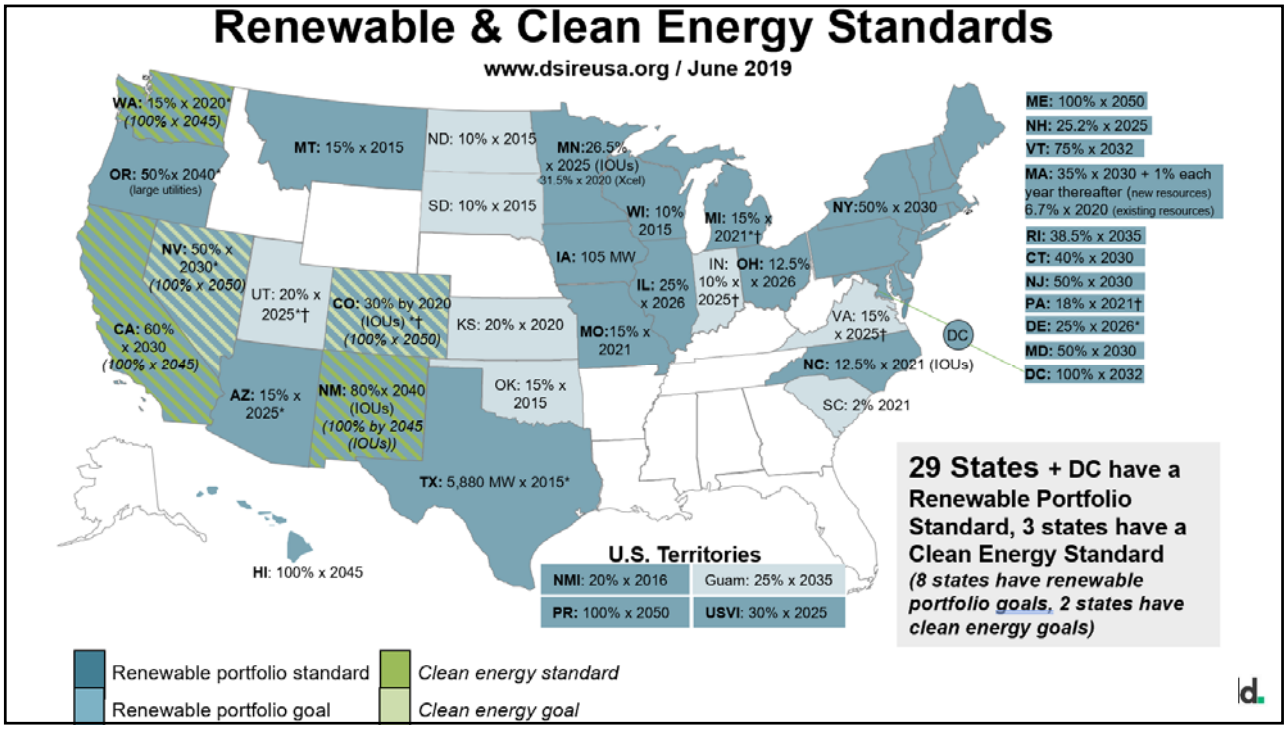
ehdd.

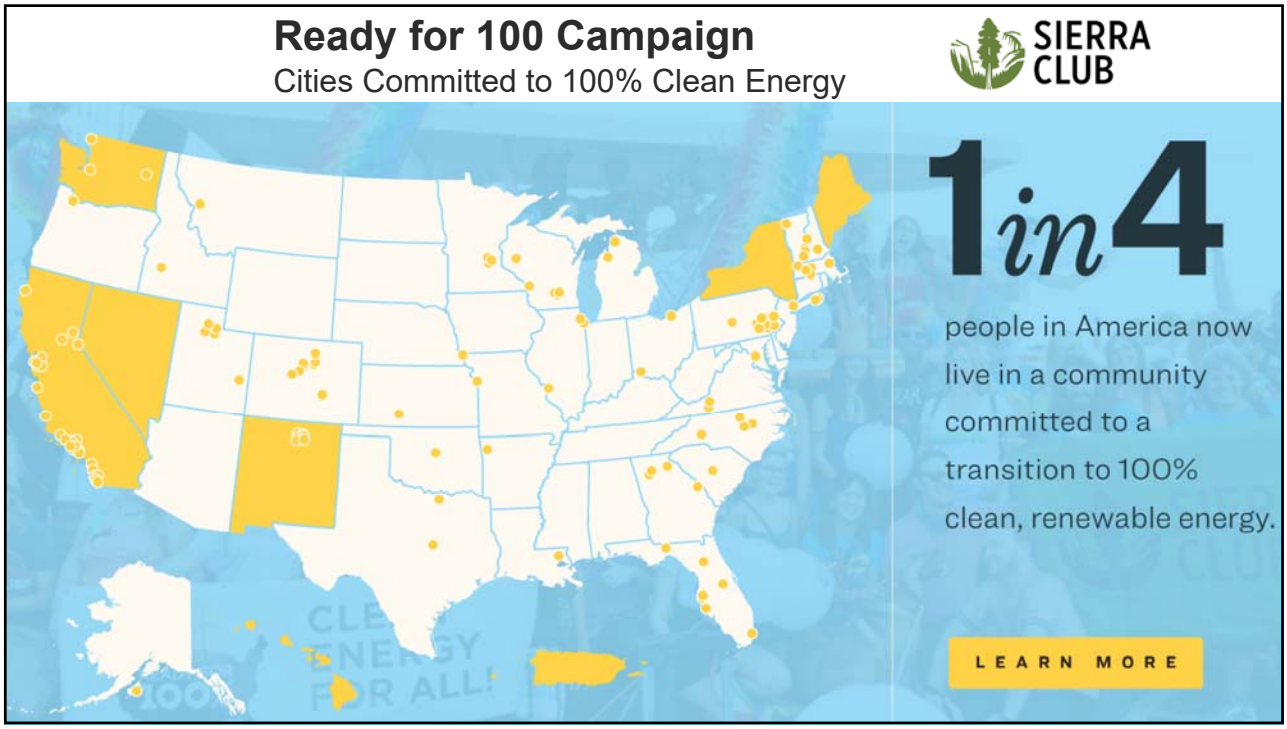
Is NZE getting us there fast enough?

ehdd.

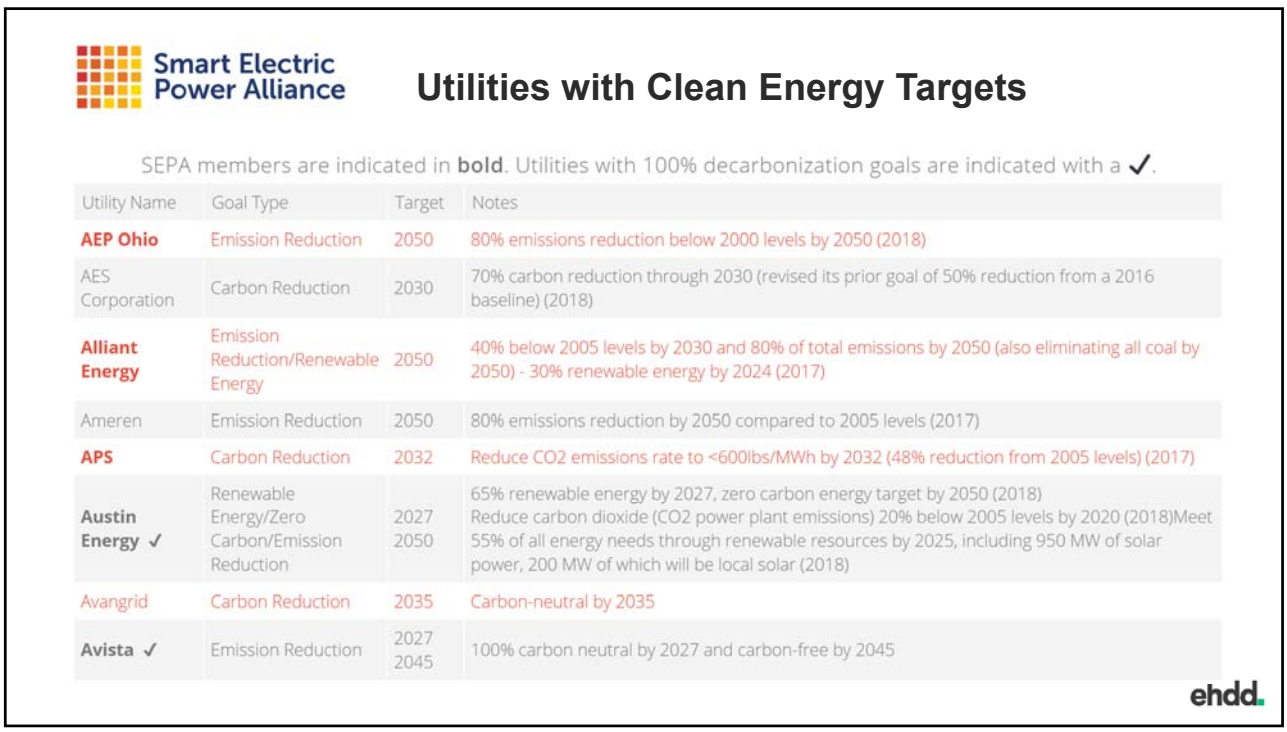


ehdd.


Renewable & Clean Energy Standards
www.dsireusa.org / June 2019
WA: 15% x 2020* (100% x 2045)
OR: 50%x 2040* (large utilities)
CA: 60% x 2030 (100% x 2045)
NV: 50% x 2030* (100% x 2050)
MT: 15% x 2015
ND: 10% x 2015
SD: 10% x 2015
MN:26.5% x 2025 (IOUs) 31.5% x 2020 (Xcel)
WI: 10% 2015
MI: 15% x 2021*†
NY:50% x 2030
IA: 105 MW
IL: 25% x 2026
IN: 10% x 2025†
OH: 12.5% x 2026
UT: 20% x 2025*†
CO: 30% by 2020 (IOUs) *† (100% x 2050)
KS: 20% x 2020
MO:15% x 2021
VA: 15% x 2025†
DC
NC: 12.5% x 2021 (IOUs)
SC: 2% 2021
AZ: 15% x 2025*
NM: 80%x 2040 (IOUs) (100% by 2045 (IOUs))
OK: 15% x 2015
TX: 5,880 MW x 2015*
HI: 100% x 2045
ME: 100% x 2050
NH: 25.2% x 2025
VT: 75% x 2032
MA: 35% x 2030 + 1% each year thereafter (new resources) 6.7% x 2020 (existing resources)
RI: 38.5% x 2035
CT: 40% x 2030
NJ: 50% x 2030
PA: 18% x 2021†
DE: 25% x 2026*
MD: 50% x 2030
DC: 100% x 2032
U.S. Territories
NMI: 20% x 2016
Guam: 25% x 2035
PR: 100% x 2050
USVI: 30% x 2025
29 States + DC have a Renewable Portfolio Standard, 3 states have a Clean Energy Standard
(8 states have renewable portfolio goals, 2 states have clean energy goals)
Renewable portfolio standard
Renewable portfolio goal
Clean energy standard
Clean energy goal


Ready for 100 Campaign
Cities Committed to 100% Clean Energy
SIERRA CLUB
1in4
people in America now live in a community committed to a transition to 100% clean, renewable energy.
LEARN MORE


RE 100
204 companies have committed to 100% renewables
IKEA
Nestlé
citi
PHILIPS
P&G
ING
JPMORGAN CHASE & CO.
AstraZeneca
WELLS FARGO
Swiss Re
FUJITSU
3M Science. Applied to Life.™
Google
Steelcase
BARCLAYS
HSBC
Goldman Sachs
hp
GM
Walmart
Adobe
AkzoNobel
Bank of America
Anthem
SONY
ABInBev
Bloomberg
Microsoft
BMW GROUP
facebook
Morgan Stanley
ehdd.


Smart Electric Power Alliance
Utilities with Clean Energy Targets
SEPA members are indicated in bold. Utilities with 100% decarbonization goals are indicated with a ✓.
Utility Name | Goal Type | Target | Notes
AEP Ohio | Emission Reduction | 2050 | 80% emissions reduction below 2000 levels by 2050 (2018)
AES Corporation | Carbon Reduction | 2030 | 70% carbon reduction through 2030 (revised its prior goal of 50% reduction from a 2016 baseline) (2018)
Alliant Energy | Emission Reduction/Renewable Energy | 2050 | 40% below 2005 levels by 2030 and 80% of total emissions by 2050 (also eliminating all coal by 2050) - 30% renewable energy by 2024 (2017)
Ameren | Emission Reduction | 2050 | 80% emissions reduction by 2050 compared to 2005 levels (2017)
APS | Carbon Reduction | 2032 | Reduce CO2 emissions rate to <600lbs/MWh by 2032 (48% reduction from 2005 levels) (2017)
Austin Energy ✓ | Renewable Energy/Zero Carbon/Emission Reduction | 2027 2050 | 65% renewable energy by 2027, zero carbon energy target by 2050 (2018) Reduce carbon dioxide (CO2 power plant emissions) 20% below 2005 levels by 2020 (2018)Meet 55% of all energy needs through renewable resources by 2025, including 950 MW of solar power, 200 MW of which will be local solar (2018)
Avangrid | Carbon Reduction | 2035 | Carbon-neutral by 2035
Avista ✓ | Emission Reduction | 2027 2045 | 100% carbon neutral by 2027 and carbon-free by 2045
ehdd.

United States Environmental Protection Agency

Green Power Partnership

Partner Name	Annual Green Power Usage (kWh)	GP % of Total Electricity Use*	Green Power Resources
1. University of California	273,347,222	25%	Various
2. University at Buffalo, the State University of New York	224,325,000	100%	Biomass, Solar
3. University of Pennsylvania	200,000,000	71%	Wind
4. Stanford University	159,626,907	57%	Solar
5. Georgetown University	159,499,000	133%	Wind
6. University of Tennessee, Knoxville	158,044,000	67%	Solar, Wind
7. University of Maryland	146,567,825	53%	Various
8. University of Oklahoma	135,692,000	70%	Wind
9. Carnegie Mellon University	132,396,967	100%	Solar, Wind
10. University of North Texas	107,250,000	100%	Solar, Wind
11. Arizona State University	105,000,000	30%	Solar, Wind
12. University of Missouri	104,001,209	42%	Biomass, Solar, Wind
13. Northwestern University	100,370,800	39%	Solar, Wind
14. Oklahoma State University	93,827,563	67%	Wind
15. Drexel University	87,766,000	104%	Solar, Wind
16. The Ohio State University	85,505,575	14%	Wind

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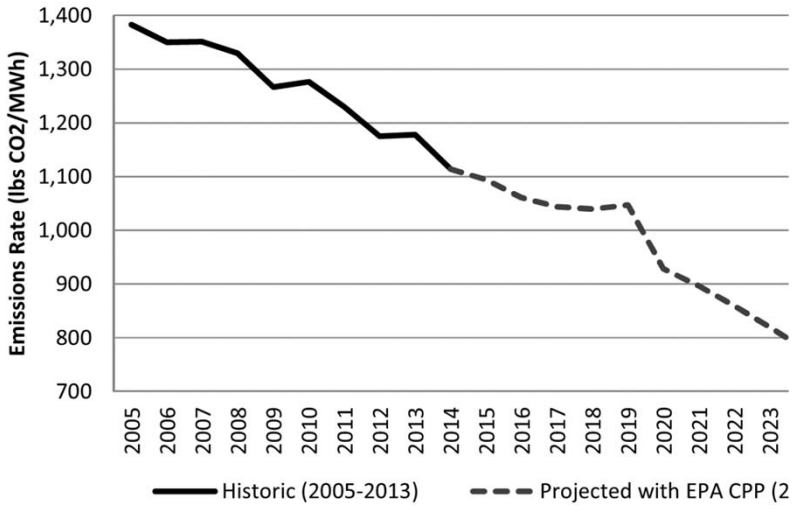
Carbon Intensity of US Electrical Generation



Keith Dennis in The Electricity Journal http://dx.doi.org/10.1016/j.tej.2015.09.019

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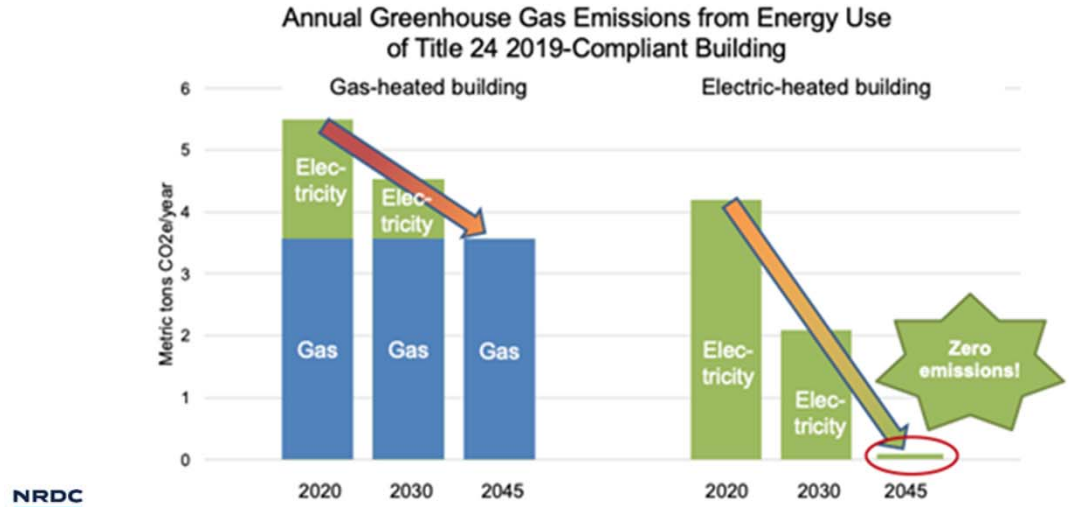
Building Electrification as Pathway to Zero Carbon

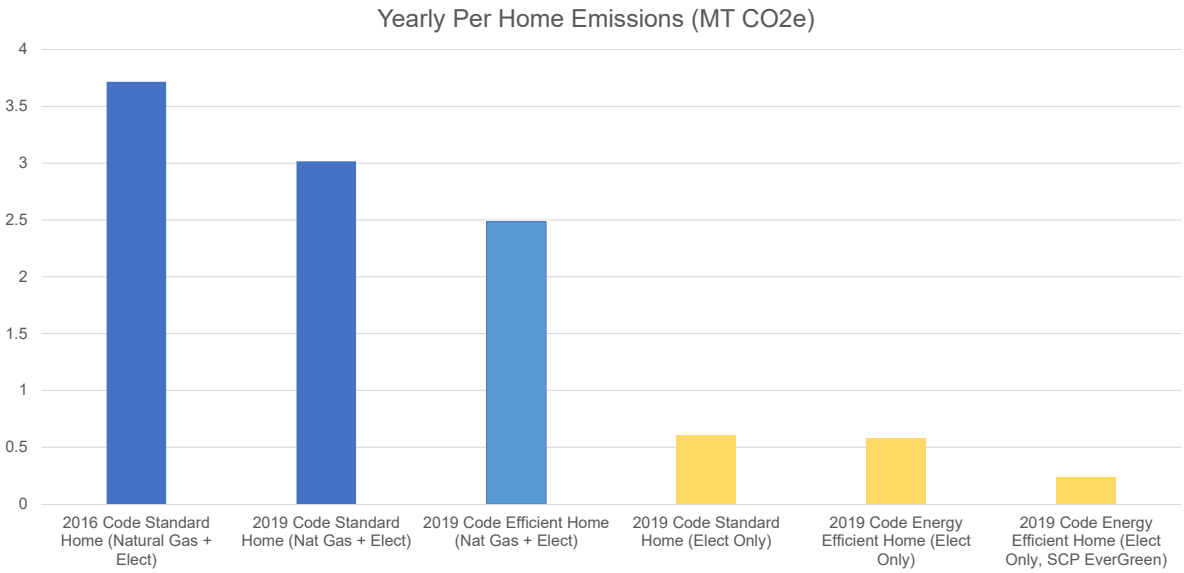


NRDC

NRDC analysis, climate zone 13 (Fresno) with rooftop solar. Including methane leakage

44

Why All Electric?



Sonoma County, low rise residential. Courtesy Rachel Kuykendall, Sonoma Clean Power

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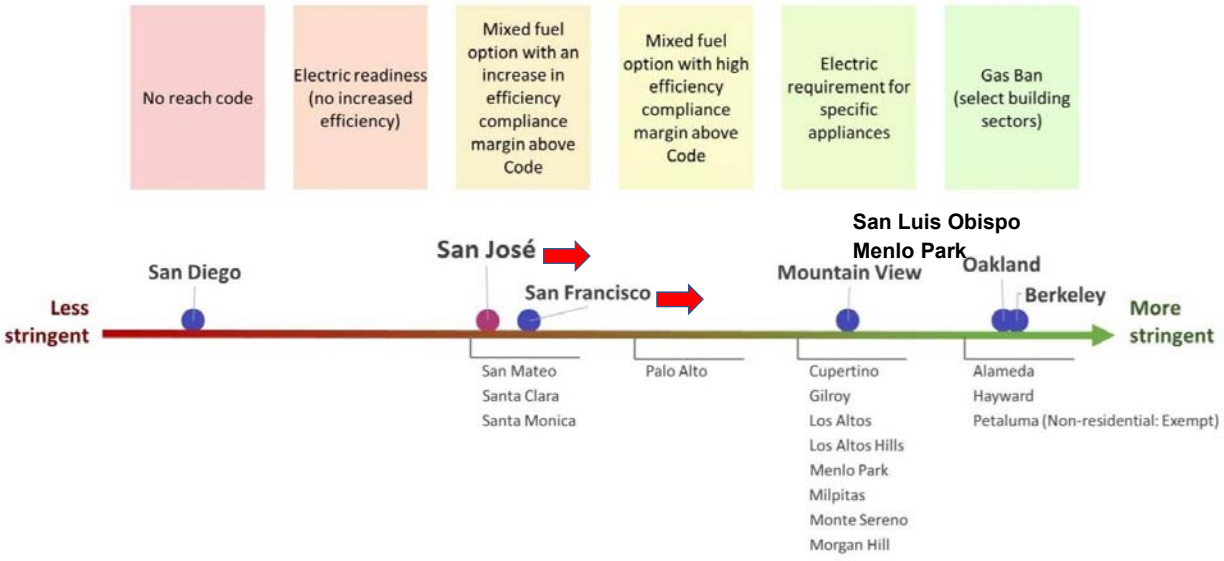
City Reach Codes - Building Electrification



Note: All information in this chart is tentative, based on information obtained to date.

ehdd.

California Universities Are Transitioning to All-Electric Buildings

The University of California system and Stanford University are making all-electric buildings the default in new construction.

JUSTIN GERDES | SEPTEMBER 24, 2018

"No new UC buildings or major renovations after June 2019, except in special circumstances, will use on-site fossil fuel combustion, such as natural gas, for space and water heating"

https://www.greentechmedia.com/articles/read/california-universities-are-transitioning-to-all-electric-buildings#gs.QUr5W_E

ehdd.

In the UK:

https://utilityweek.co.uk/gas-connections-new-homes-banned-2025/

https://www.ft.com/content/3f50601c-45a5-11e9-b168-96a37d002cd3

ehdd.

The Netherlands

Removing gas from 30,000-50,000 existing homes/year thru 2022
Then 200,000 homes/year

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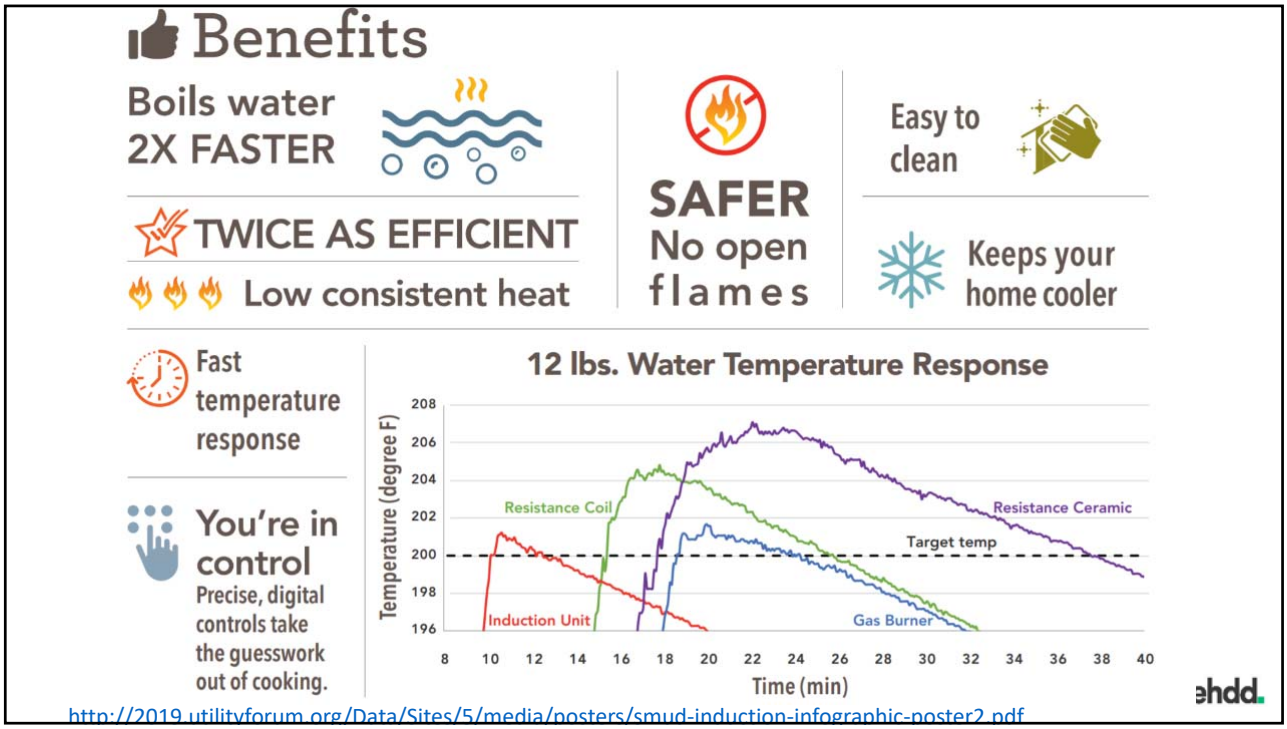
Induction: SMUD's cooking now

Customer research

SMUD customer panel: **How would you rate your impression of induction cooking before and after trying the induction cooktop?**

http://2019.utilityforum.org/Data/Sites/5/media/posters/smud-induction-infographic-poster2.pdf



http://2019.utilityforum.org/Data/Sites/5/media/posters/smud-induction-infographic-poster2.pdf

2018 – 10 Top Rated Cooktops

	Score	Cooktop
1.	100	Induction - Samsung $2,000
2.	100	Induction – Dacor $3,100
3.	99	Induction – GE $1,800
4.	99	Induction – GE $1,440
5.	99	Induction – GE $2,600
6.	99	Induction – Kenmore $1,600
7.	99	Induction – Bosch $1,700
8.	97	Induction – Kenmore $1,200
9.	97	Induction – Frigidaire $700
10.	97	Induction – Frigidaire $820
...	94	top rated Electric cooktop $900
...	94	top rated Electric cooktop $1,400
...	89	top rated Gas cooktop $1,350

CR Consumer Reports