1

AT A GLANCE

Dense/Urban

7th Largest

55K Students

Diverse

Low-Income

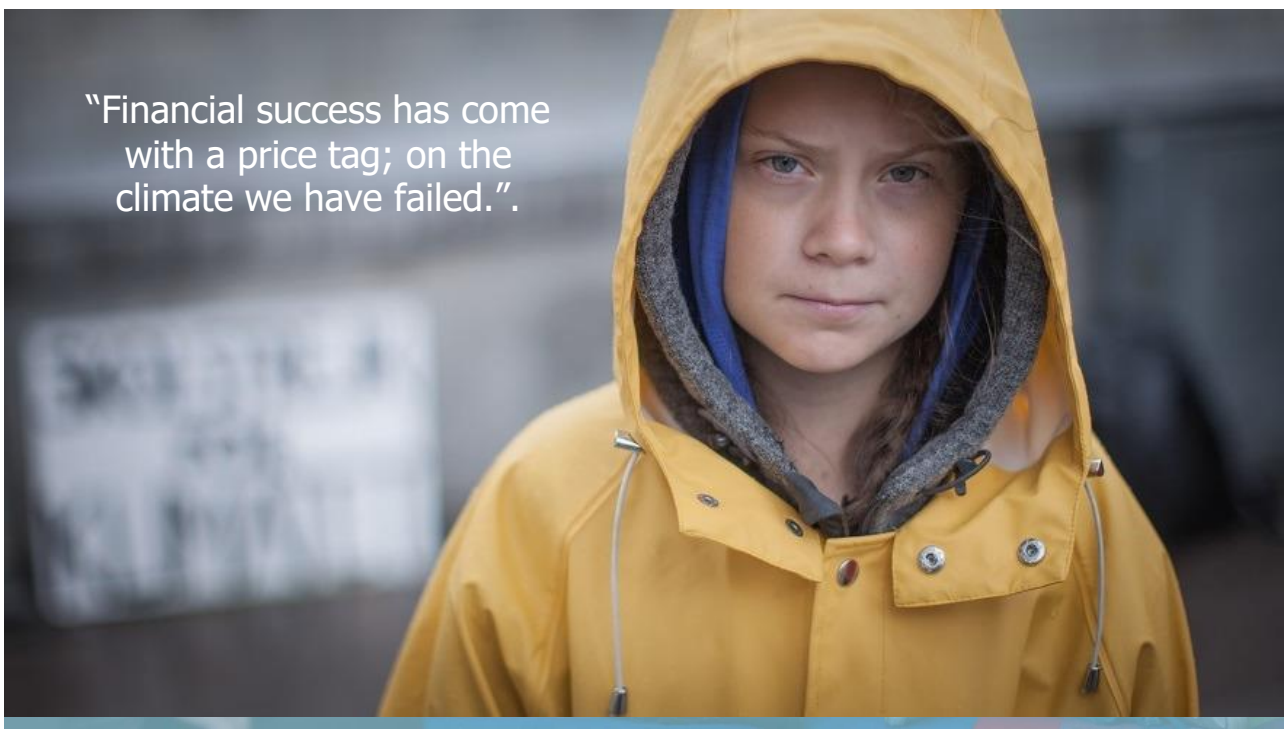
Voters

Private

2


SKOLSTREJK
FÖR
KLIMATET

3


"Financial success has come with a price tag; on the climate we have failed.".

4

I don’t want your hope.

I don’t want you to be hopeful.

I want you to panic…and act as if your house was on fire.

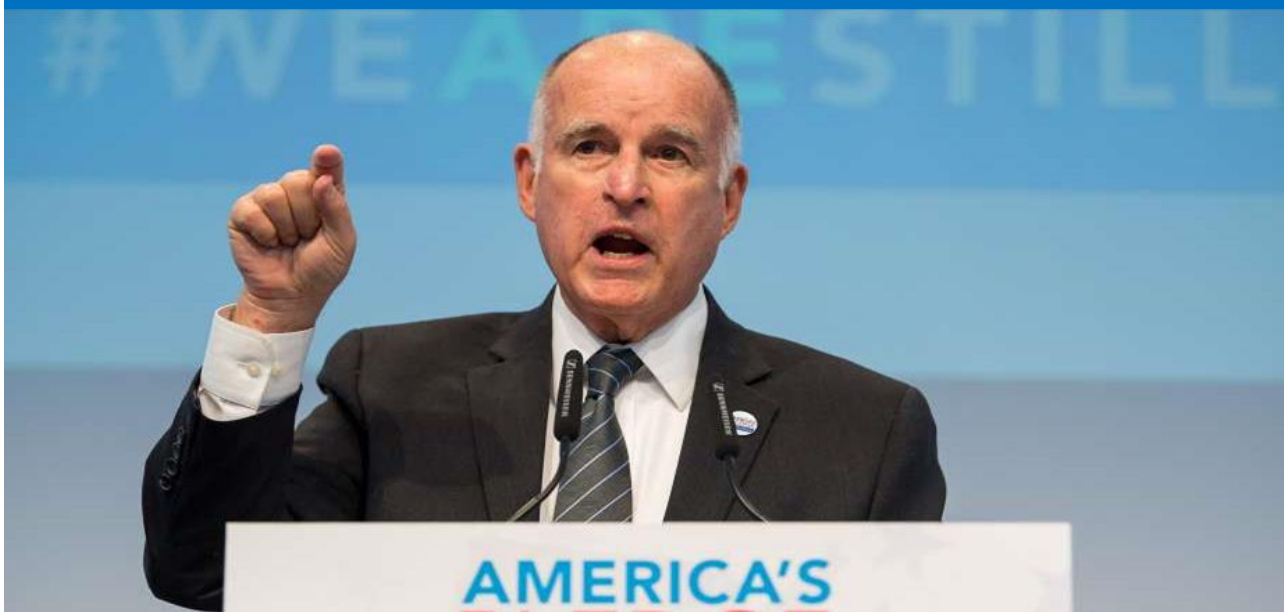
Because it is.

5

6

7

BOLD LEADERSHIP



8

California's ZNE Building Goals

- *All new residential construction and all new commercial construction in California will be zero net energy by 2020 and 2030, respectively*
- *50% of existing commercial buildings will be retrofit to ZNE by 2030*
- *All new state buildings and major renovations shall be ZNE (2025)*
- *50% of existing state-owned building area by 2025 shall be ZNE*
- *IOUs shall launch and ramp a ZNE K-12 Schools and Community College Pilot Program in 2015-18*

DPR Construction San Diego Corporate Office , Chip Fox, DG&E, renovation

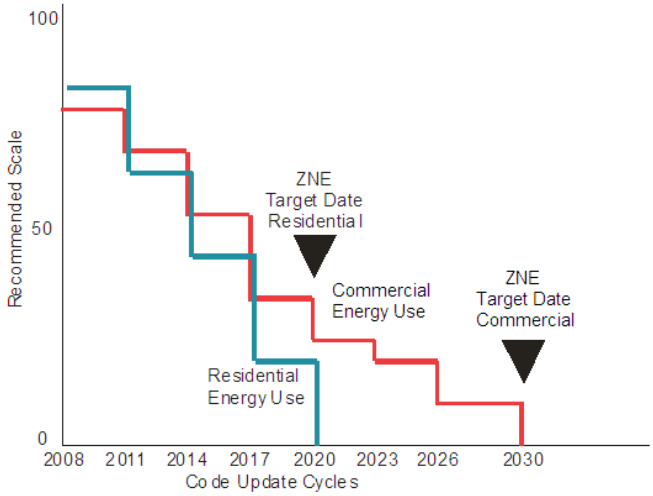
IBEW ZNE Center, San Leandro, renovation

Source: CPUC

2

9

DOABLE



Source: NBI

10

THEIR SCHOOL

Source: SOM

11

OUR SCHOOLS

12

California's ZNE Building Goals

- *All new residential construction and all new commercial construction in California will be zero net energy by 2020 and 2030, respectively*
- *50% of existing commercial buildings will be retrofit to ZNE by 2030*
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DPR Construction San Diego Corporate Office , Chip Fox, DG&E, renovation

IBEW ZNE Center, San Leandro, renovation

Source: CPUC

2

13

Oh, SH%T!

14

DOABLE?!

15

EUI GOAL

Table 29. Energy Intensity Values for Zero Energy Schools

Climate Zone	Representative City	Primary School		Secondary School	
		Site Energy (kBtu/ft²·yr)	Source Energy (kBtu/ft²·yr)	Site Energy (kBtu/ft²·yr)	Source Energy (kBtu/ft²·yr)
1A	Miami, FL	25.9	76.4	23.1	68.5
2A	Houston, TX	24.3	71.1	21.7	63.5
2B	Phoenix, AZ	24.7	72.5	21.9	64.3
3A	Memphis, TN	23.8	69.0	21.2	61.6
3B	El Paso, TX	23.4	67.8	20.7	60.2
3C	San Francisco, CA	21.6	61.9	19.0	54.3
4A	Baltimore, MD	23.5	67.6	[illegible].9	60.1
4B	Albuquerque, NM	23.1	66.6	[illegible].4	58.8
4C	Salem, OR	22.4	64.2	19.7	56.4
5A	Chicago, IL	24.3	69.9	21.6	62.2
5B	Boise, ID	23.2	66.7	20.4	58.4
6A	Burlington, VT	24.5	70.1	21.6	61.9
6B	Helena, MT	23.5	66.9	20.5	58.4
7	Duluth, MN	25.9	74.1	22.8	65.1
8	Fairbanks, AL	28.7	82.5	25.0	71.5

Source: DOE

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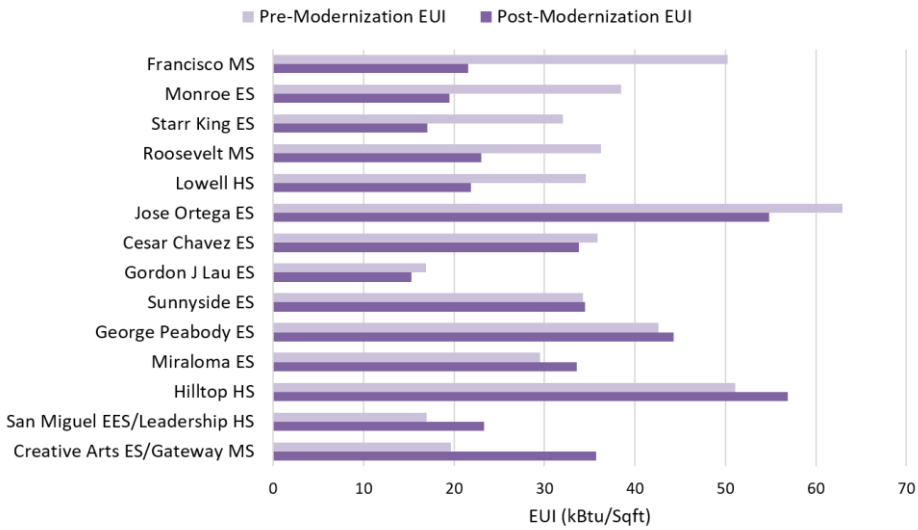
THERE'S HOPE



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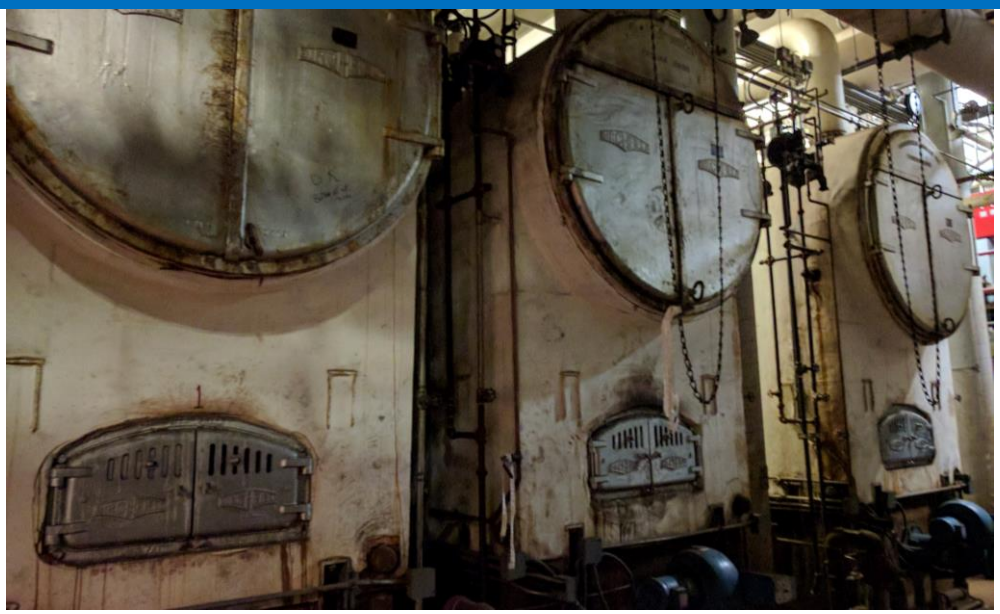
CURRENT TECH



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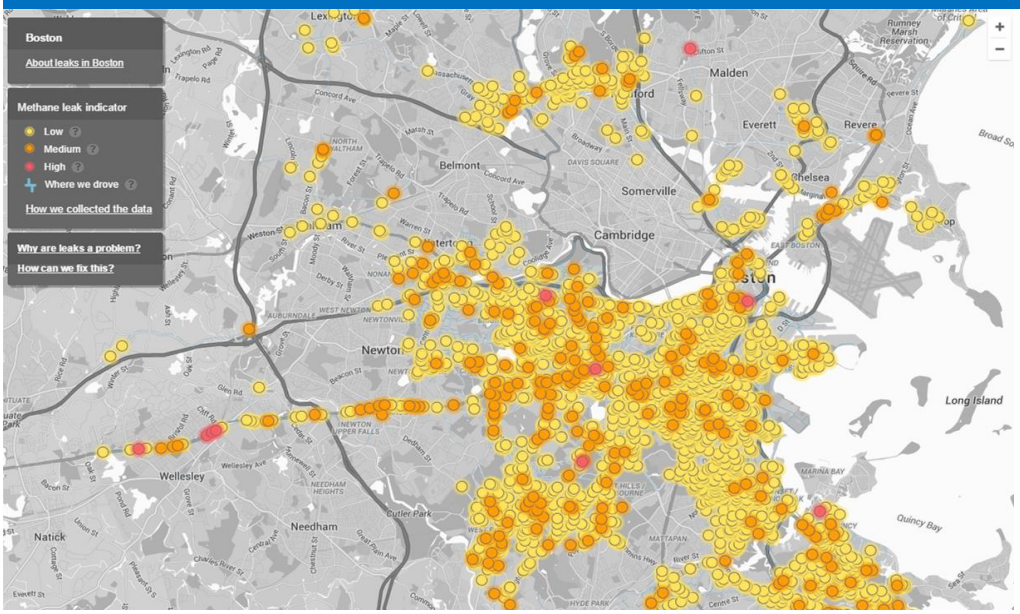
TRANSITION FUEL?



Source: Environmental Defense

19

THE ONLY WAY

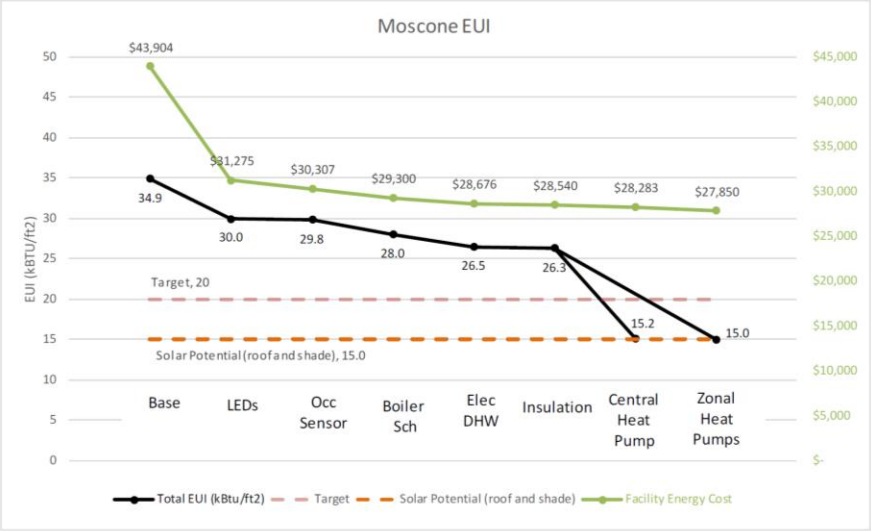


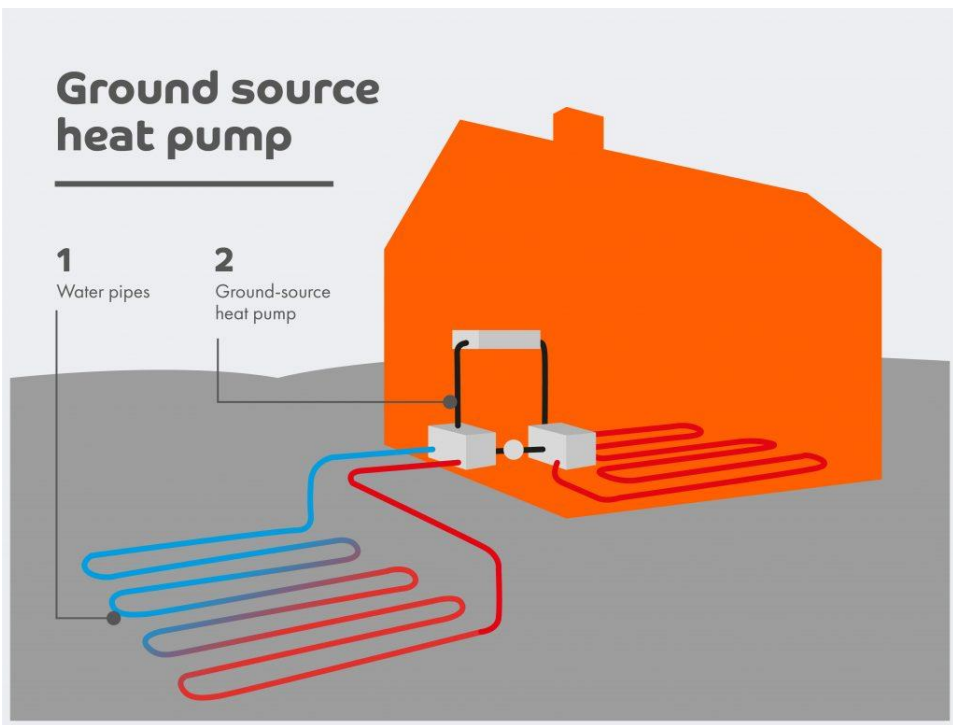
Figure 5.1: EUI and Total Energy Cost for Moscone ES

20

HEAT PUMPS

Source: Sanyo

21



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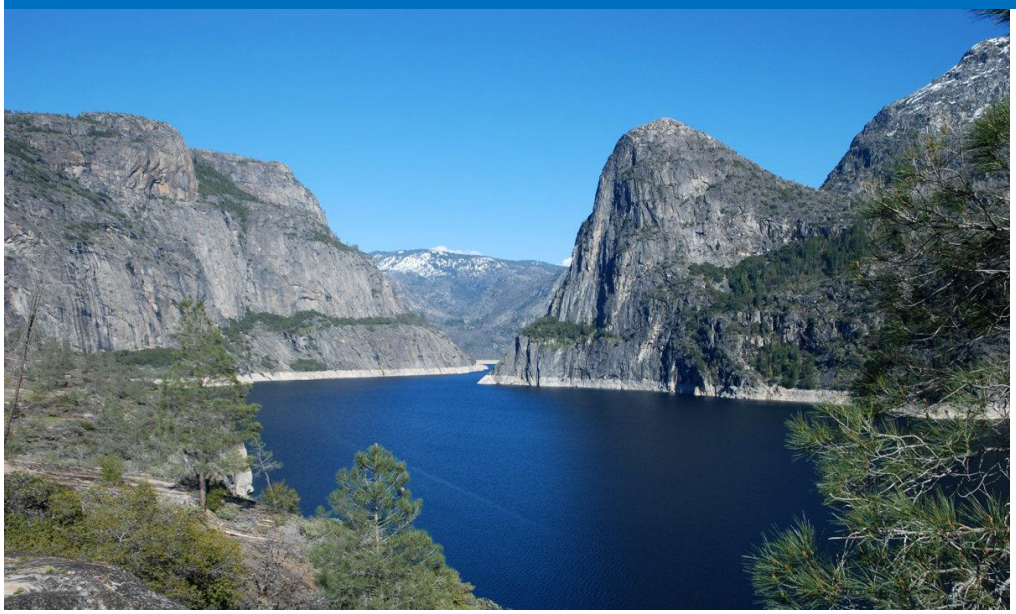
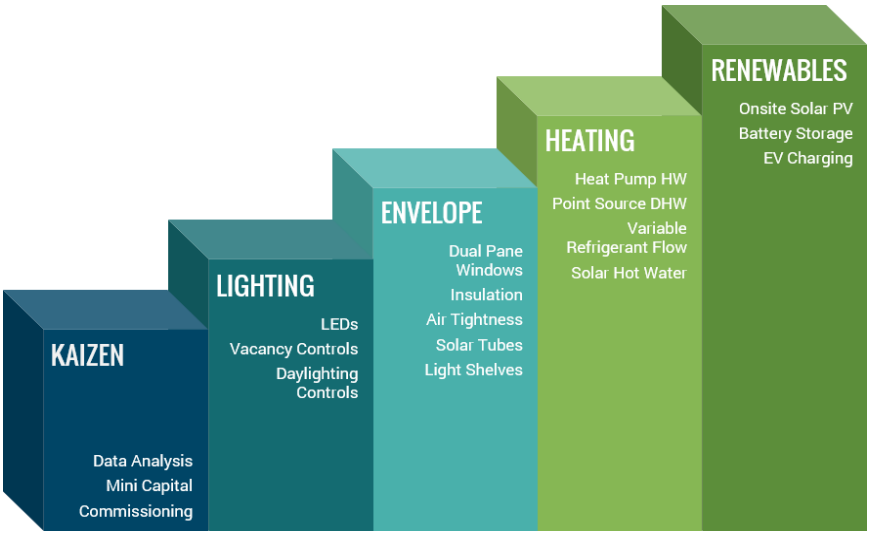
UTILITY PERKS



Source:
SF Public Utilities Commission

23

LABOR ISSUES



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HOW TO PAY FOR THEM?

- ➔ Bonds
- ➔ Deferred Maintenance
- ➔ Developer Fees
- ➔ Prop 39
- ➔ Utility Company
- ➔ ECAA Loans
- ➔ PPAs

Source: UC Berkeley

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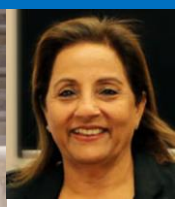
CONSTANT BATTLE



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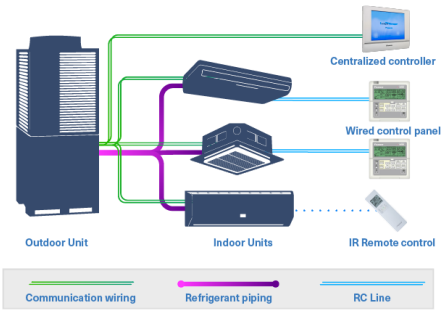
MINIMIZE THE DELTA



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BUILDING STRATEGY

NEW SCHOOLS

→ ZNE Ready

MODERNIZATION

→ System Replacements

RENEWABLES

→ In Due Time

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EXECUTION IS EVERYTHING

Source: Pinterest

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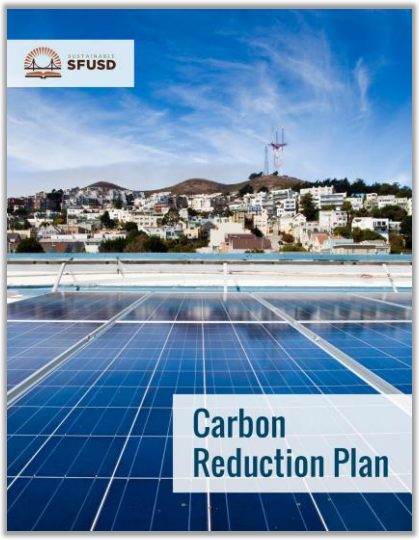
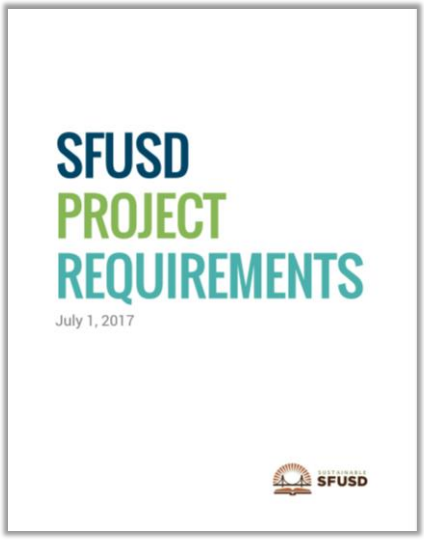
PUBLIC & INTERNAL





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OVERVIEW & PROCESS

STRATEGY

The District has many opportunities to improve the carbon footprint of its buildings:

BOND PROJECTS: voter-approved funding for new construction & major renovations provides the best opportunity for deep energy retrofits

MONITORING: post-occupancy commissioning and energy monitoring can identify opportunities to adjust operation to meet design intent

OPERATIONS & SHARED SAVINGS: preventative maintenance, energy and water monitoring, and engagement of users prevent rising energy and water usage as buildings age

FACILITIES PROJECTS: major repairs and deferred maintenance projects provide an opportunity to improve energy and water efficiency

These *SFUSD Owner's Project Requirements* were created to assist design teams in supporting the District's ambitious zero carbon goals. The following pages describe the process for incorporating ZNE-ready design into new buildings, bond modernizations, and facilities projects. In summary:

New Buildings will be designed to achieve an Energy Use Intensity (EUI) < 20 kBTU/sf/yr. SFUSD's preferred strategies for achieving such exemplary energy efficiency are outlined in the *ZNE Guidelines* at the end of this document. While the addition of renewable energy is generally outside the scope of new projects, solar readiness should be built into the building.

Bond Modernizations will focus on improvements to the lighting systems and building envelope as outlined in *ZNE Assessments* commissioned by the District for every project prior to the design phase. These assessments will also look for opportunities to improve heating and ventilation systems, but these items will generally be tackled in future bonds unless broken equipment necessitates earlier action.

Facilities Projects generally have limited scope and will support ZNE goals by upgrading building elements as they wear out. In each case, the *ZNE Guidelines* below and *District Design Standards + Guidelines* (DDSG) will inform the design and selection of materials and/or equipment for these projects.

5

PROCESS

New Buildings

Ensuring that the District's energy targets are faithfully met in new construction projects requires a rigorous design process, stellar construction techniques, and attention to quality control. To ensure the best possible outcome on each and every project, SFUSD requires architects to incorporate the following elements into the process of creating new buildings:

CHARRETTE: All projects will commence with an architect-led design charrette specifically focused on identifying the strategies and systems necessary for meeting the EUI performance goal. At a minimum, the Project Manager, Sustainability Office, Buildings & Grounds, Design Team, Commissioning Agent, and Electrical/Mechanical/Civil consultants will attend.

ENERGY MODELING: Building form, massing, orientation, and roof layout (among other design parameters) have a significant impact on energy usage and solar energy production. Therefore, design decisions shall be evaluated against a constantly refined energy model from the earliest stages of a project. In this way, project architects will have many opportunities for course correction should site conditions or non-energy parameters make achievement of ZNE goals difficult.

COMMISSIONING: Commissioning agents hired by the District will be brought into the design process early on and follow each project through design, construction, and post-occupancy to ensure that design intent is achieved as outlined in this document and reflected in the Basis of Design (BOD). The *Commissioning Plan* will include design reviews, construction inspections, functional testing, development of a maintenance manual, and systems training (see Commissioning Procedures in the 2016 Bond Program *Procedures + Standards Binder*).

First ZNE Projects

SFUSD is in the process of designing its first new ZNE building at Claire Lilienthal School on Divisadero St. The building will house the middle school program of this K-8 school and replaced eight existing bungalows. The second ZNE project is a PG&E-supported modernization of Garfield Elementary on Telegraph Hill. The utility is particularly interested in identifying design solutions in the constrained urban environment.

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NEW & OLD

ZNE GUIDELINES

Design teams working with SFUSD are asked to design buildings that are:

HEALTHY... maximizing daylight and air quality and minimizing harmful pollutants.

BEAUTIFUL... encouraging pride and engagement among families and the community.

EFFICIENT... reducing energy use to a minimum to facilitate achievement of ZNE.

VALUABLE... minimizing lifecycle costs and reducing maintenance as much as possible.

In order to achieve adequate levels of efficiency in San Francisco, design teams should consult the Department of Energy's (DOE) Technical Feasibility Study for Zero Energy K-12 Schools and follow the *ZNE Guidelines* below. While these guidelines are most easily implemented in new construction, they should also be utilized where applicable in bond modernization and facilities projects.

ENERGY: New buildings should be designed to achieve a modeled **Energy Use Intensity (EUI) of 15-20 kBTU/sf/yr**, a value that allows rooftop solar to offset yearly energy usage for a typical 2-3 story San Francisco school. Building systems should be **"designed for off"**, meaning that they will shut down without user intervention. **Solar analysis** during **Schematic Design (SD)** should confirm that rooftop solar potential will be adequate to cover modeled energy usage.

FORM: Buildings should be simple and compact, oriented to the sun, with a depth & layout that allows **daylight harvesting**, **natural ventilation**, **outside views**, and use of **thermal mass**.

MAINTENANCE: Every effort should be made to **facilitate maintenance access** to building systems (without ladders/lifts and without disturbing classes), materials should be chosen that are **easy to clean** and **inexpensive to maintain**, and design teams are encouraged to **expose** the **functional elements** of the building for students to see.

ENVELOPE: In order to minimize the heating load, wall, window, and door **insulation** levels should be **optimized** via building modeling to comply with the EUI target above. **Exterior insulation** should be specified **over cavity insulation** where possible. **Fiberglass batts** are **never allowed** due to poor thermal performance in the field. Moisture and air **control layers** should reside on the **warm side of exterior insulation** and architects should specify **airtight construction** practices. **Rain screens** are encouraged to enhance durability.

10

to be spread out over multiple bond cycles, recognizing that there generally are not enough funds assigned to each site to do all necessary work in one round of modernization. In cases where unique opportunities arise to replace an entire heating system, bond sustainability funds, Prop 39 funding, and/or support from the SF Public Utilities Commission (SFPUC) may allow a quicker approach.

The chart below summarizes which elements will be incorporated into each 2016 bond project and which will only be included on a case-by-case basis. Design teams will consider recommendations from the ZNE audit, synergies with other scope, available funding, and site-specific design parameters to determine which of the latter to include.

	MODERNIZATION		FUNDING			
SCOPE	Mandatory	Case-by-case	Bond	Sustainability	Prop 39	Utility
Air sealing weather-stripping around all doors/windows	✓		✓			
Window replacements if windows deteriorating		✓	✓			
Insulation cost-effective (reroofing, attics, open walls)	✓		✓			
LED lighting with daylighting and vacancy controls	✓		✓			
Solar tubes/skylights common areas		✓		✓		
Light shelves/shading classrooms and offices		✓	✓	✓		
EMS upgrades latest standard; connect all spaces	✓		✓			
Building dashboard site usage & solar (if applicable)	✓			✓		
Fuel switch/transformer when replacing end-of-life heating/DHW systems		✓	✓	✓	✓	✓
Heating optimization EM, VFD, EGPD pumps, pipe insulation, steam traps, radiator bypass	✓		✓	✓	✓	✓
Solar readiness roofing, conduit, space		✓	✓	✓		✓
Piping leak repairs and pipe insulation	✓		✓			
DHW reconfiguration close to use; eliminate recirc		✓	✓	✓	✓	
Water fixture upgrades high-flow fixtures	✓		✓			
Shut-off valves at all upgraded bathrooms	✓		✓			
FWH pre-plumbing where wall cavity accessible		✓		✓		
Irrigation as identified in SFPUC Landscape Technical Assistance Program (LTAP)		✓		✓		
Turf replacement where existing lawn sports field		✓		✓		✓
Stormwater control where > 5000sf disturbance		✓	✓	✓		
Bottle fillers cafeteria & one per floor	✓		✓			
Washing machines shut-out and appliance; no dryer	✓		✓			
Hand dryers upon approval of spec	✓		✓			
Trash sorting outdoor/indoor sorting areas where space		✓	✓			
Walking & biking infrastructure striping, bike racks	✓			✓		

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SAN FRANCISCO UNIFIED SCHOOL DISTRICT
DISTRICT DESIGN STANDARDS + GUIDELINES
2016 PROPOSITION A BOND PROGRAM
SFUSD FACILITIES DESIGN + CONSTRUCTION

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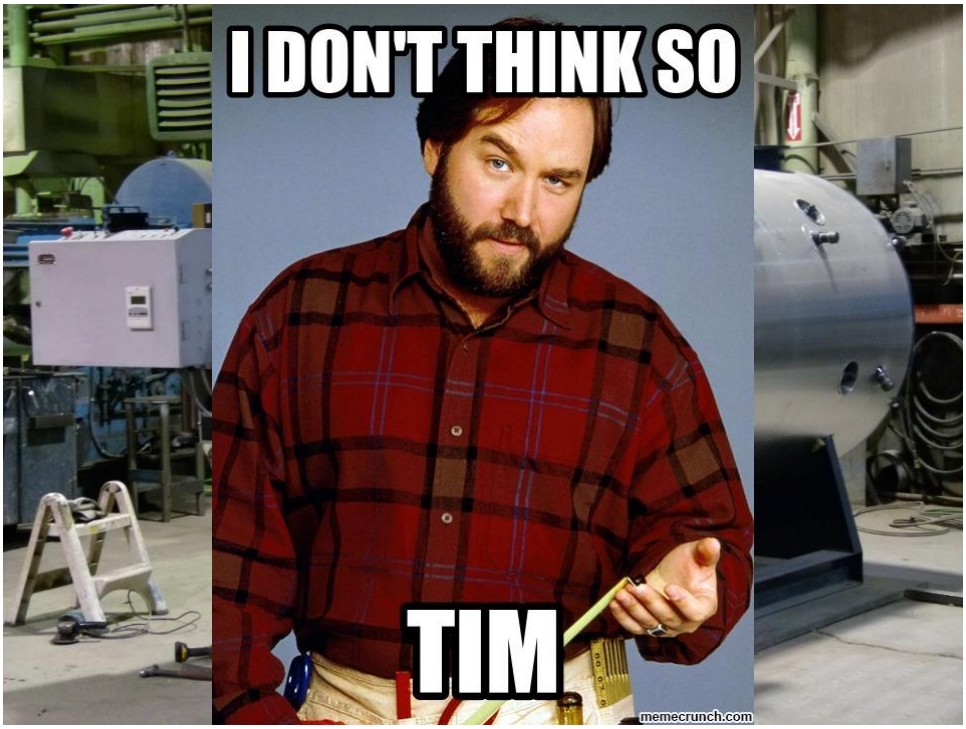

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COMMISSIONING

36

SMALLER PROJECTS

- ➔ LED Lighting
- ➔ Windows
- ➔ Roofing
- ➔ Controls
- ➔ Hot Water
- ➔ Pipe Insulation
- ➔ NO: New Gas Boilers

Source: Alta Planning

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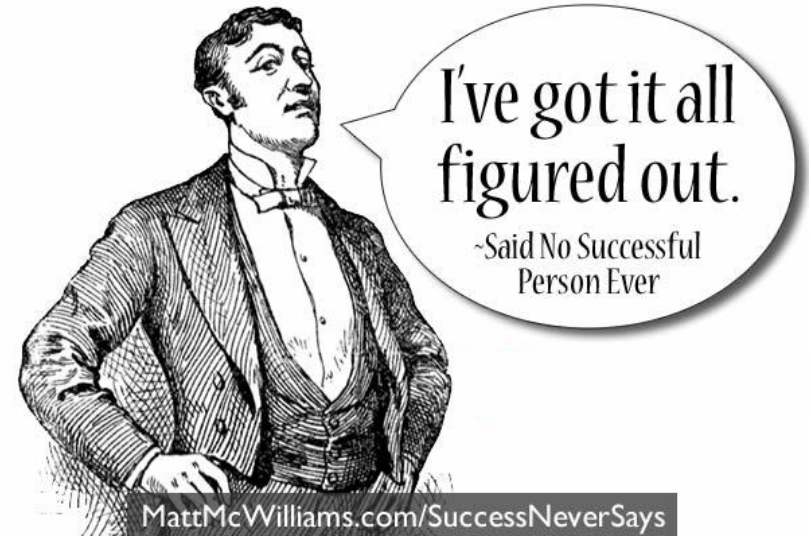

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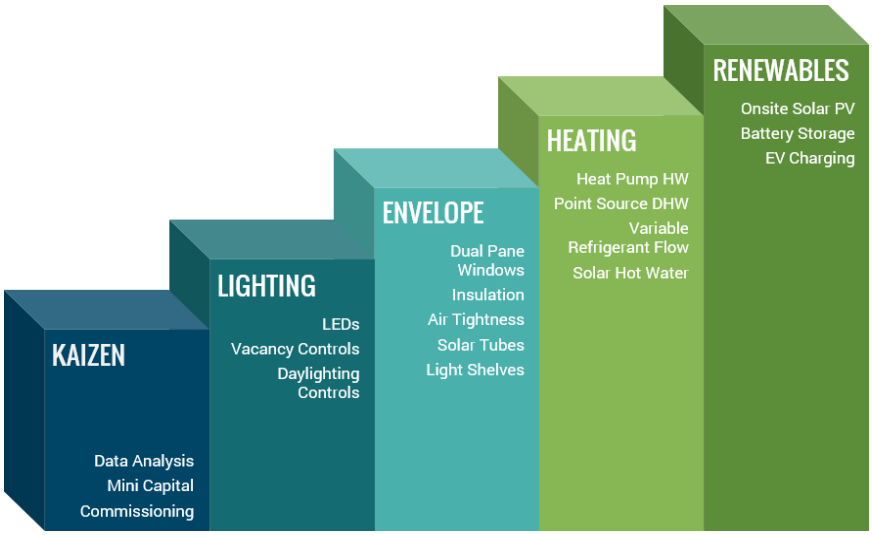
ZNE STAIRCASE



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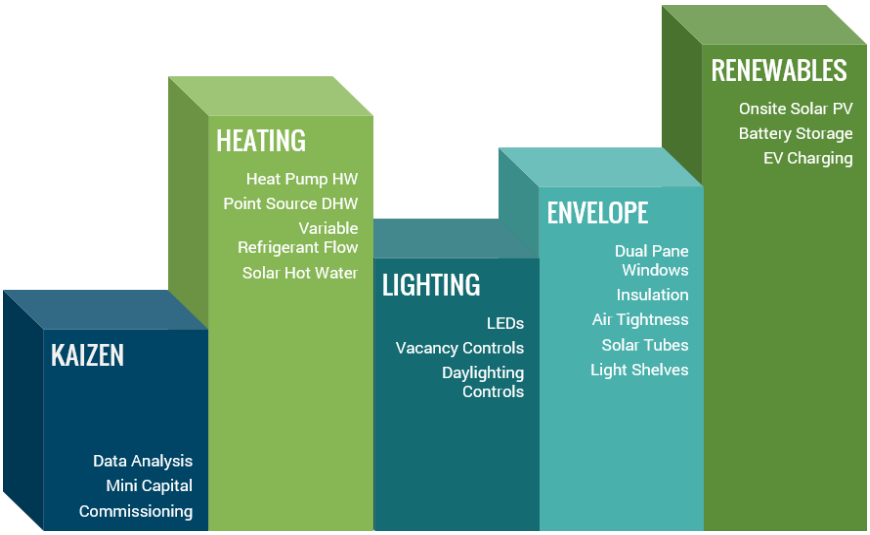
ZNE ADVENTURE



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NEW ZNC BUILDINGS

42

PURE JOY

Source: NY Times

43

IT'S ON!

44

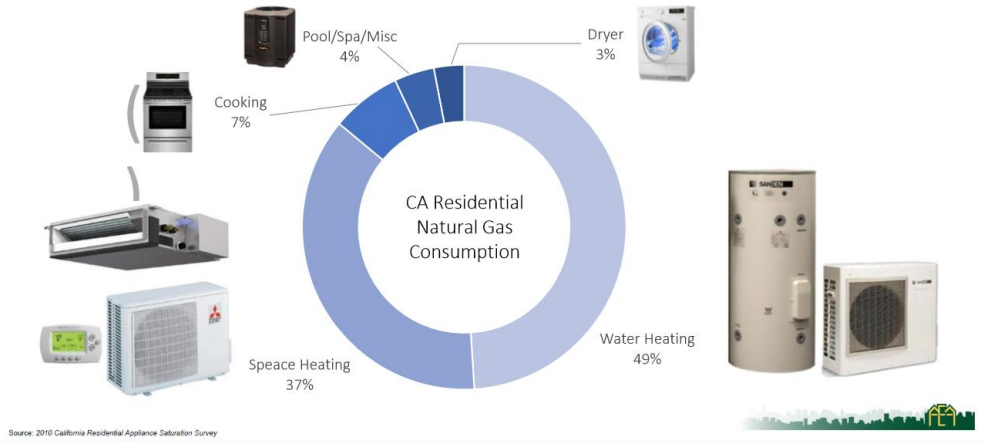
45

LESSONS LEARNED

46

HEAT PUMPS ARE COMING

"Electric equipment isn't available"



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TAKE IT SLOW

HEATING OPTIONS

1. Stick with working systems
2. Choose passive strategies
3. Pilot @ few sites

→ There's always next time!

Figure 2: Original boilers natural gas-fired heating hot water boilers

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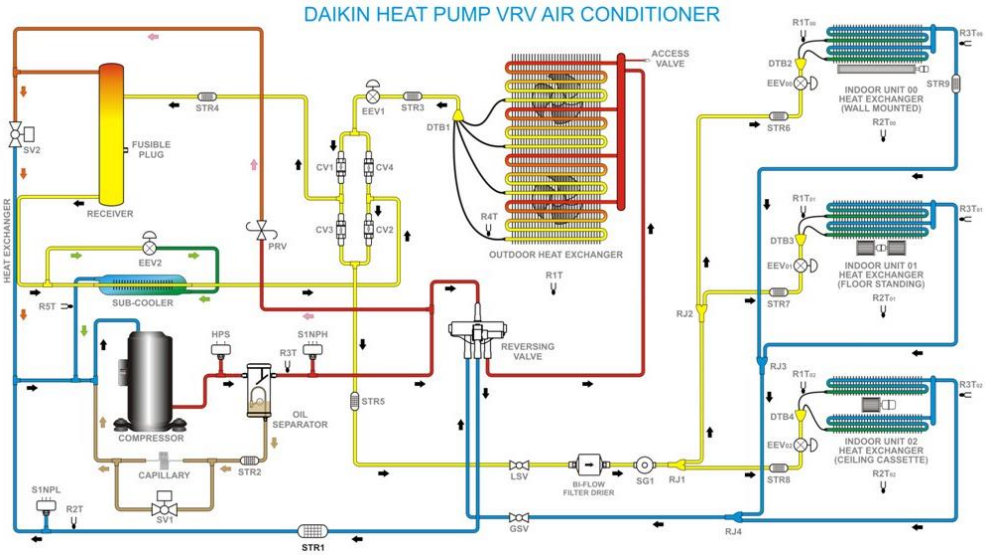
HEAT PUMPS ARE COMPLEX



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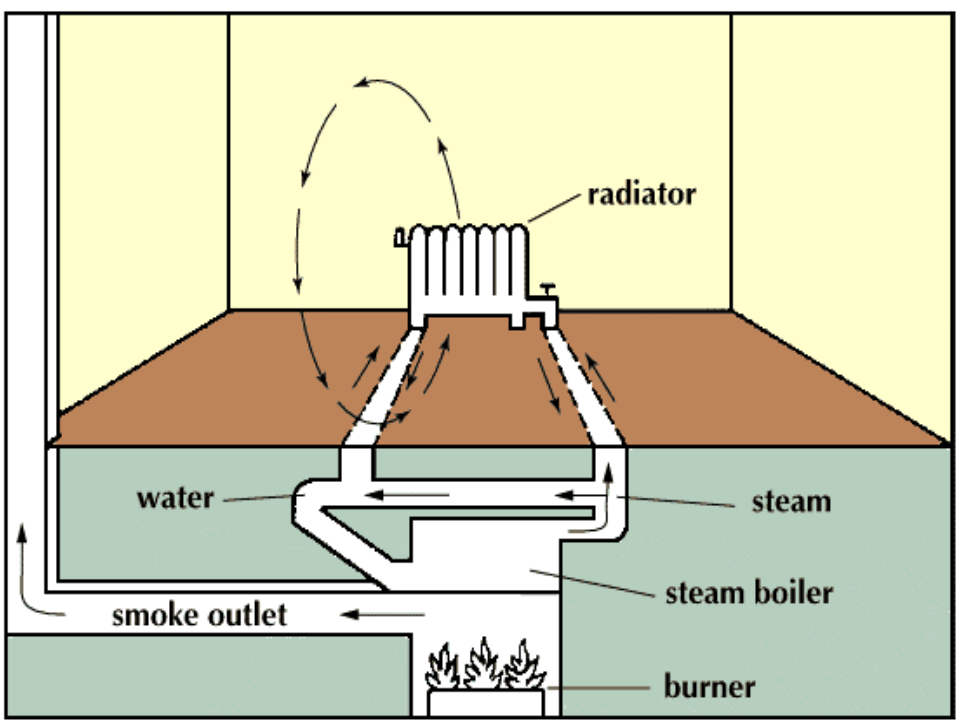

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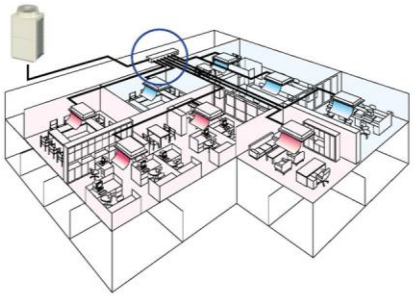
CHOOSE WISELY



HEAT PUMPS

1. Three types
2. Multiple brands
3. Interface w/EMS

→ Choose wisely!

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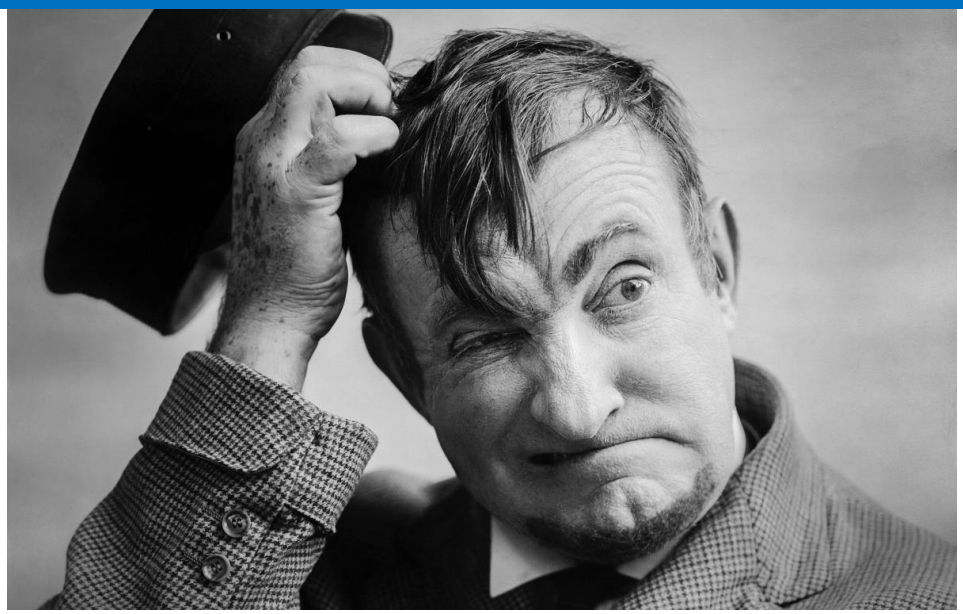
HEAT PUMPS ARE NEW



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TRAINING IS KEY

53

SOME THINGS TAKE TIME

ELECTRIC DHW

1. Split maintenance
2. Recovery rate
3. Replacement costs

→ Only @ fuel switch

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LOOK AHEAD

55

EITHER OR

VS.

56

BOTH AND

+

57

KEY TAKEAWAYS

- **Create a framework**
- **- involve stakeholders**
- **- set energy targets**
- **- consider utility rates**
- **Share it with design teams**
- **- but check their work**
- **Be ambitious but pragmatic**
- **Compromise with colleagues**

Source: FCPA

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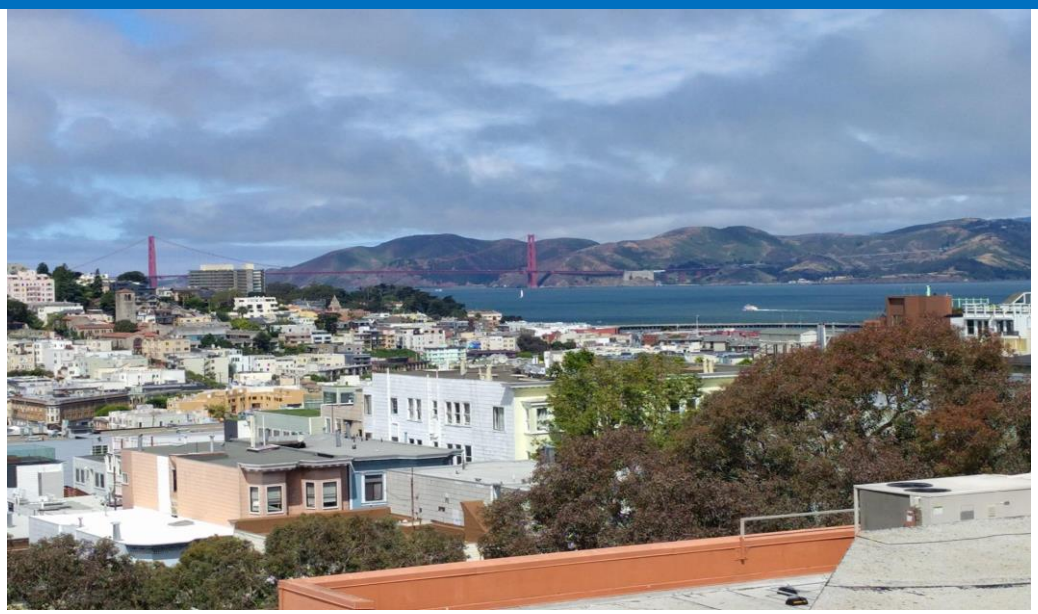
QUESTIONS?



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