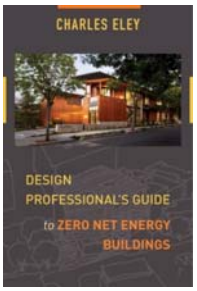


Codes and Standards

October 10, 2019

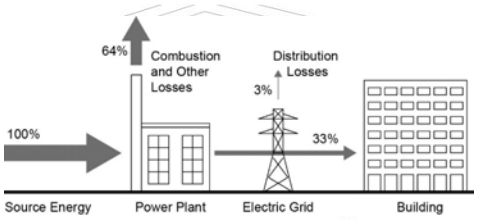
Charles Eley,

FAIA, PE, FASHRAE
Senior Fellow Architecture 2030
Senior Fellow New Buildings Institute

California Building Performance Metrics

Architecture 2030 Reach Code

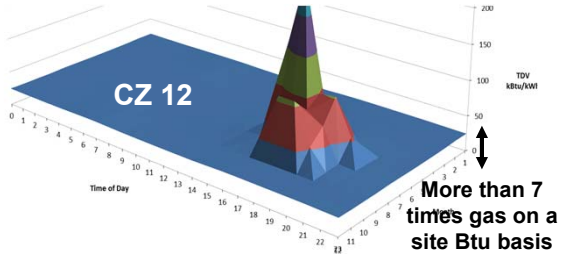
Period	Metric	Water Heater Energy Compared to Gas		
		Basis	Heat Pump	Resistance
1978-2005	Source Energy	Energy	35%	135%
2005-2019	Time-Dependent Valued Energy (TDV)	Cost	48%	183%
ZERO Code	Time-Dependent Source Energy (TDS)	Carbon	18%	67%
T24 2022	???	???	???	???



Dynamic Electricity Metrics

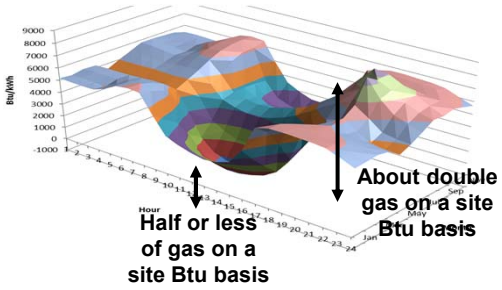
TDV (Time Dependent Valued)

- Basis is cost



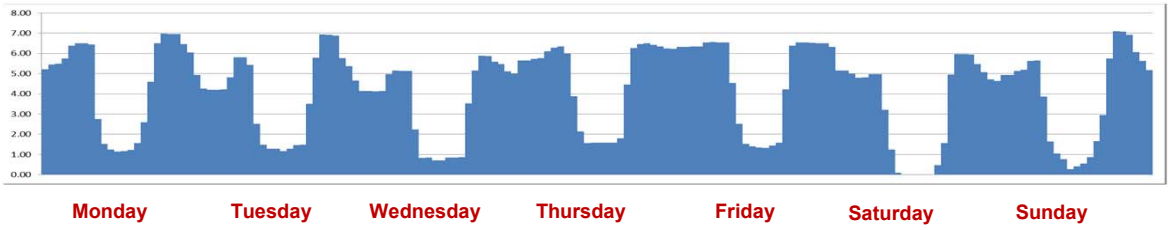
TDS (Time Dependent Source)

- Basis is source energy/carbon

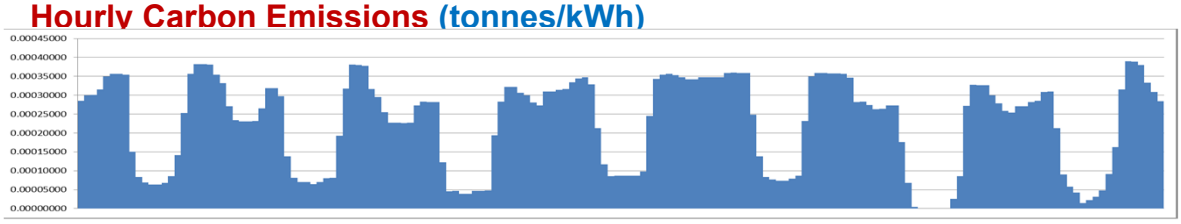


Patterns of TDS and Carbon Emissions are Identical

Time-Dependent Source Energy (kBtu/kWh)

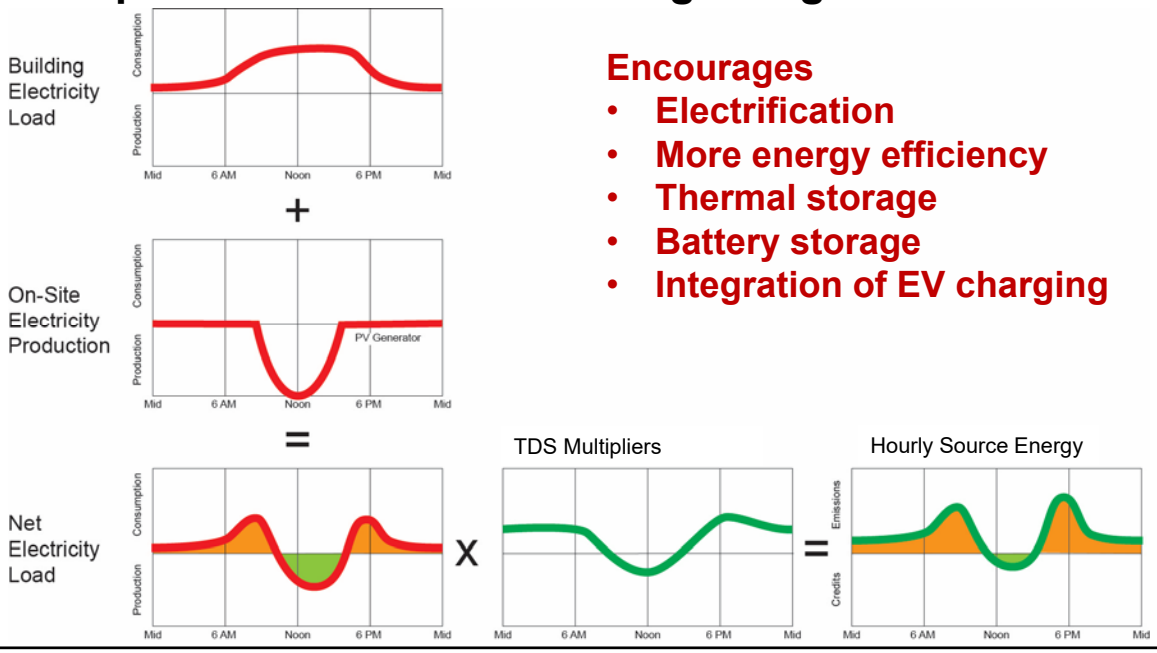


Hourly Carbon Emissions (tonnes/kWh)



California Building Energy Efficiency Standards (BEES)

Impact of TDS to ZNE Building Design



Encourages

- **Electrification**
- **More energy efficiency**
- **Thermal storage**
- **Battery storage**
- **Integration of EV charging**

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California Building Energy Efficiency Standards (BEES)

Baseline Building Space Heating – 2019 Standard

Residential

- Depends on proposed design, but one of the following:
  - Gas furnace with ducts
  - Split-system heat pump with ducts
  - Split-system heat pump without ducts

Nonresidential

- Mostly gas, but system type depends on primary building activity, building area and number of floors

Neutral

But breakers and wires must be provided for future electric equipment

Penalizes Electricity

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California Building Energy Efficiency Standards (BEES)

Baseline Building Water Heating System – 2019 Standard

Residential

- Depends on proposed design, but one of the following:
  - Gas instantaneous (most common)
  - NAECA minimum heat pump PV supplement or compact distribution and drain water heat recovery
  - NEEA advanced heat pump water heater

Neutral

Nonresidential

- Gas

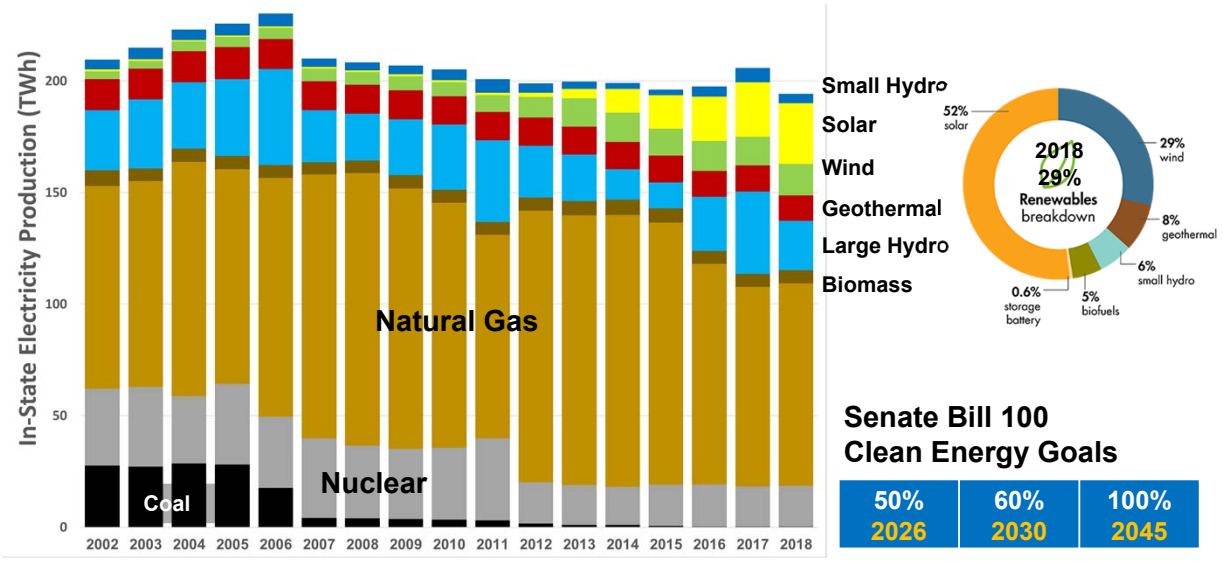
Penalizes Electricity

Wrapup

Recommendations for California BEES

- Set an electric baseline for energy performance calculations
- Use a metric like TDS that properly reflects relative carbon emissions of gas and electric equipment

California Electric Generation



Senate Bill 100
Clean Energy Goals

50%	60%	100%
2026	2030	2045

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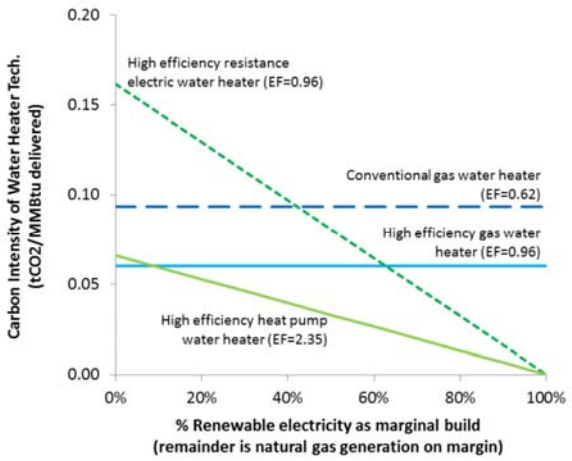
Carbon Emissions

As the electric grid gets cleaner, electric space heating and water heating look better and better compared to gas.



Amber Mahone, et. al., "What if Efficiency Goals were Carbon Goals?", ACEEE Summer Study 2016

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National Level Codes

ASHRAE Standard 189.1 and the IgCC

eGRID Subregion	Average Source Multiplier	CO_2e Emission (lb/MWh)
ASCC Alaska Grid	2.52	1,580
ASCC Miscellaneous	1.21	738
WECC Southwest	2.75	1,496
WECC California	1.94	957
ERCOT All	2.58	1,529
FRCC All	2.97	1,601
HICC Miscellaneous	2.86	1,717
HICC Oahu	3.83	2,460
MRO East	3.08	2,337
MRO West	2.50	1,686
NPCC New England	2.87	1,024
WECC Northwest	1.39	936
NPCC NYC/Westchester	2.92	1,034
NPCC Long Island	2.90	1,600
NPCC Upstate NY	1.97	540
RFC East	3.05	1,156
RFC Michigan	3.06	1,806
RFC West	3.14	1,757
WECC Rockies	2.33	1,829
SPP North	2.67	1,851
SPP South	2.46	1,737
SERC Mississippi Valley	2.95	1,421
SERC Midwest	3.20	2,234
SERC South	3.04	1,651
SERC Tennessee Valley	3.02	1,677
SERC Virginia/Carolina	3.11	1,255
United States as a Whole	2.64	1,418

Three performance tests:

- Cost,
- Carbon Emissions and
- Source Energy

California Reach Codes

Local California Reach Codes – Adopted

- **Berkeley** – No more gas hookups in new buildings after January 1, 2020
- **Carlsbad** – Either heat pump water heaters or solar thermal required for low-rise residential
- **San Luis Obispo** – Fees on natural gas to offset climate change

CEC Requirements
10-106 Locally Adopted Energy Standards

- **Determination of cost effectiveness**
- **Must result in less energy use than state standards**

California Reach Codes

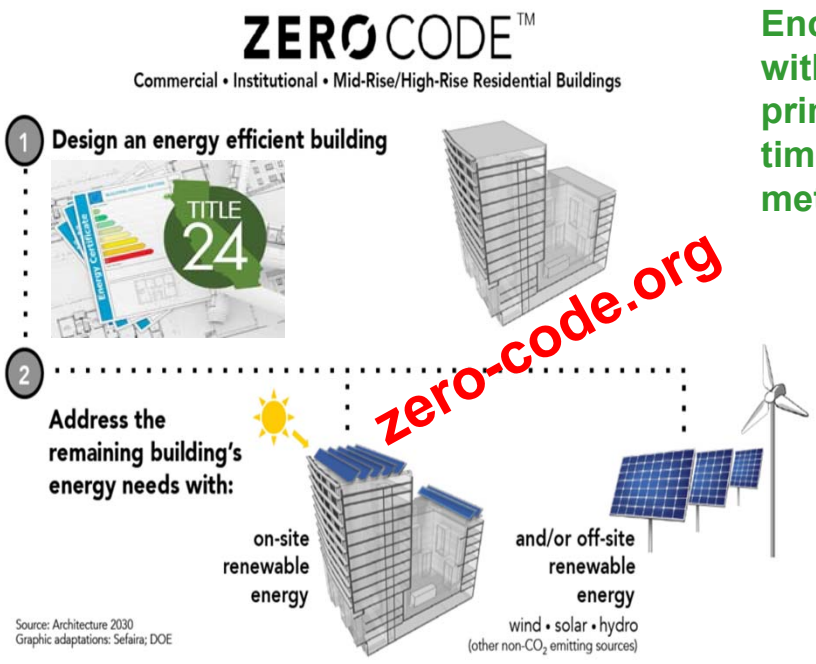
Local California Reach Codes – Pending

- **San Francisco** – Large commercial buildings to buy 100% clean electricity
- **San Jose** – Solar ready, electric space and water heating or higher efficiency gas and ability to change in the future
- **Santa Monica** – Electric-preferred
- **Menlo Park** – All-electric except for cooking and fireplaces
- **Windsor** – All-electric only, low-rise residential only

Possibilities

- **Los Angeles**
- **Mountain View**
- **Los Altos**
- **Morgan Hill**

California Reach Codes



Encourages electrification without mandating it, primarily because of the time-dependent source metric