



2019 Building Energy Efficiency Standards Overview

BayREN Forum March 3, 2019



2019 T24 Standards Goals

1. Increase building energy efficiency cost effectively
2. Contribute to the State's GHG reduction and ZNE goals through energy efficiency and renewables
3. Substantially reduce the home's impact on the grid through energy efficiency, grid harmonization and maximizing self-utilization of PV generation
4. Remove barriers to building electrification





Policy Drivers

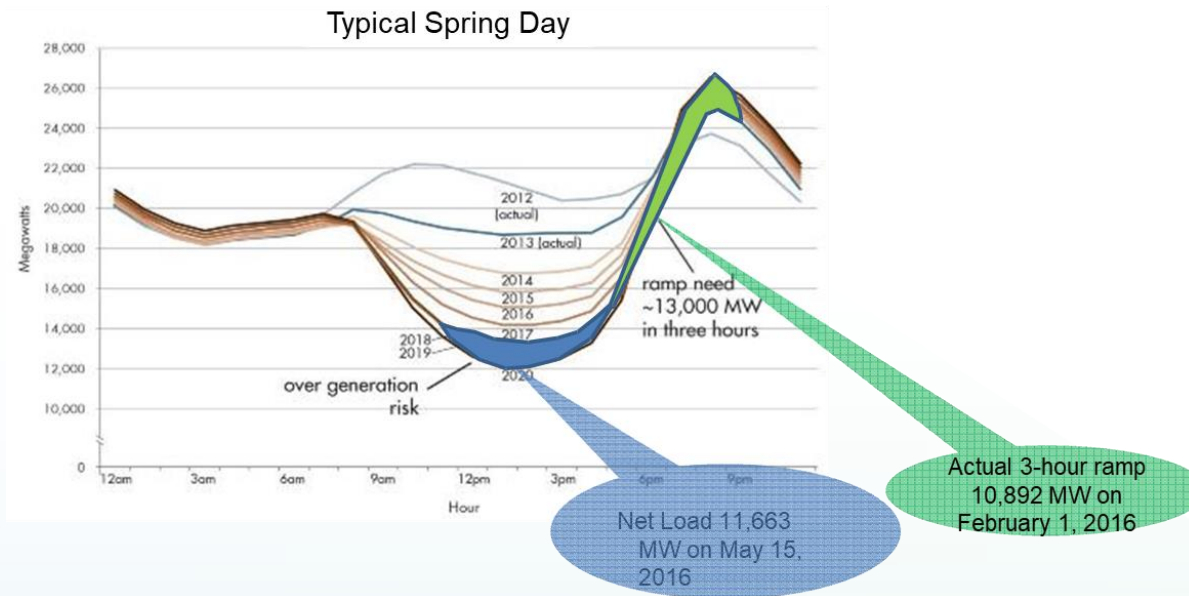
- The ZNE Policy was initiated under the Schwarzenegger administrations and continued under the Brown Administration. The following policy documents establish the goal for new building standards to achieve ZNE by 2020 for residences and by 2030 for nonresidential buildings:
- 2008 CPUC/CEC Energy Action Plan – Endorsement by both agencies of ZNE for Residential buildings by 2020 and nonresidential buildings by 2030
- 2008 CPUC California Long Term Energy Efficiency Strategic Plan
- 2008 CARB Climate Change Scoping Plan
- 2007 (and later) CEC Integrated Energy Policy Report (IEPR)
- Governor's "Clean Energy Jobs Plan"





Bad Duck

Oversupply and Ramping: A challenge as more renewables are integrated into the grid



Solutions
Target energy efficiency
Increase storage and demand response
Enable economic dispatch of renewables
Decarbonize transportation fuels
Retrofit existing power plants
Align time-of-use rates with system conditions
Diversify resource portfolio
Deepen regional coordination



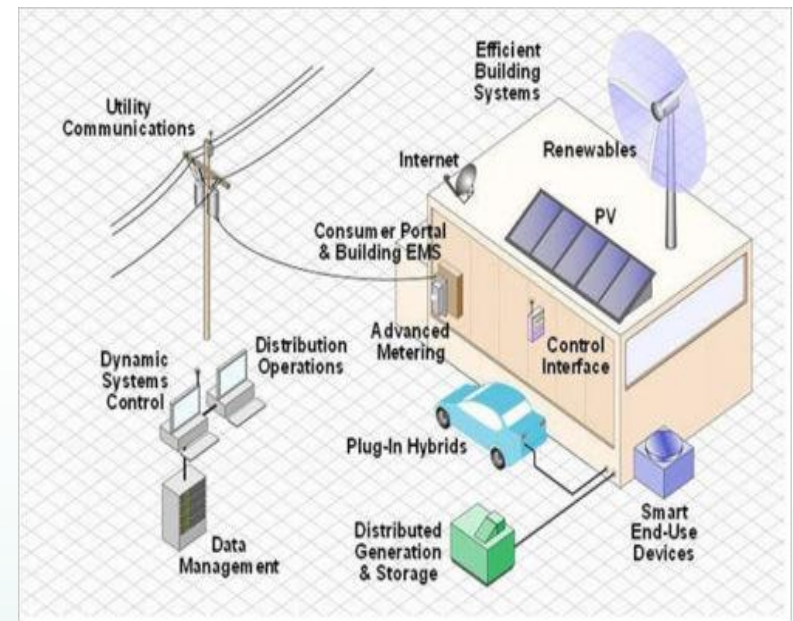
Grid Harmonization

Grid harmonization strategies (GHS) when coupled with customer owned PV systems bring **maximum benefits to the grid, environment, and occupants**

Grid Harmonization Strategies Defined:

Grid Harmonization are strategies and measures that allow the home occupants to use their energy assets to maximize self-utilization of PV array output, and limit grid exports to periods beneficial to the grid and the ratepayer;

Examples of GHS include but are not limited to PVs in combination with battery storage, demand response, thermal storage, and in the future Electric Vehicle (EV) harmonization.

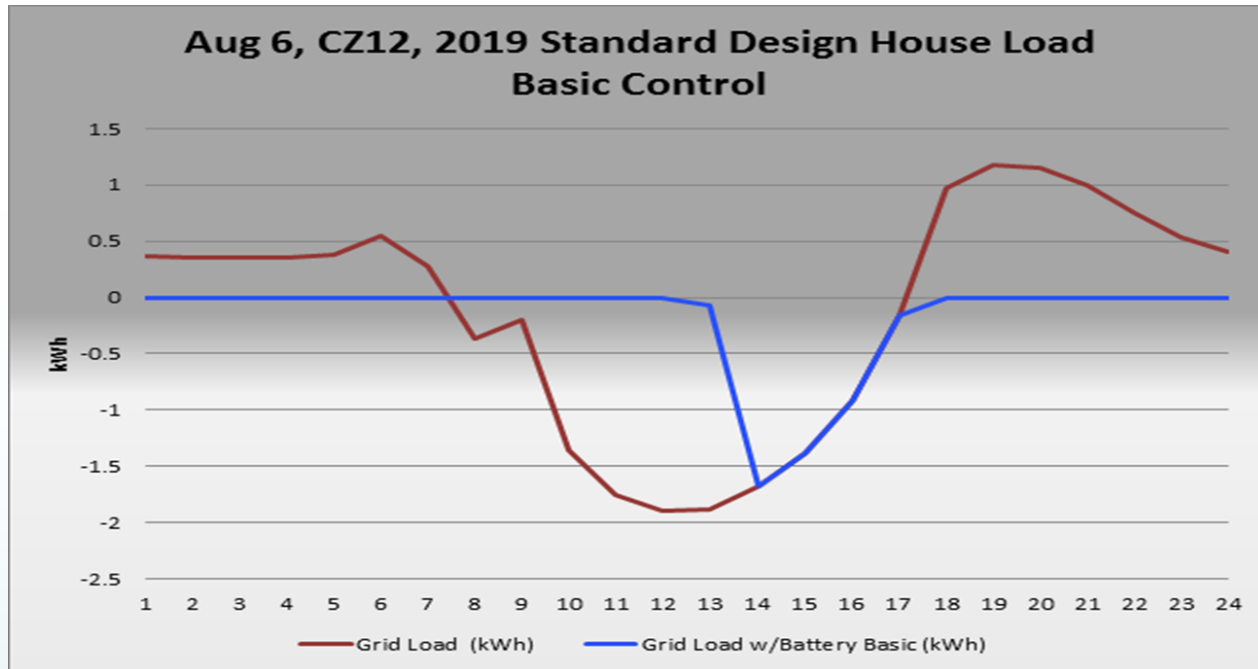




Good Duck

The Invisible House - PV Plus Basic Battery – A “Mild” Summer Day

“Annual” netting assumes all hours of the day/year have the same emission and energy cost values, not a correct assumption - **Blue line** smooths out the belly of the duck and achieves zero carbon and zero energy without resorting to netting





2019 T24 Highlights

The 2019 Standards include the following efficiency and generation resource highlights:

1. Envelope efficiency: High performance attic (HPA) R-19 between rafters, high performance walls (HPW) U-factor 0.048, Quality Insulation Installation (QII), better windows with 0.30 U-factor and 0.23 SHGC
2. “Right-sized” PV system, determined by NEM Rules
3. Removing barriers to building electrification, and
4. Incentives for grid harmonization strategies that maximize self-utilization of the PV output and limit exports to the grid

PV are a prescriptive requirement, but batteries are only a compliance option



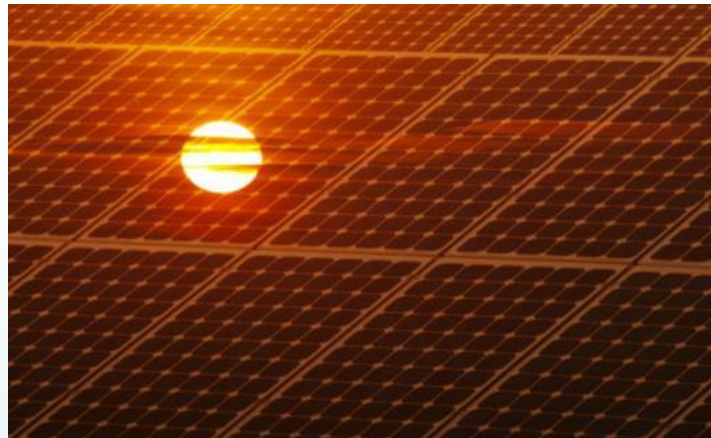


2019 T24 Highlights

For the first time, 2019 Standards include prescriptive solar PV systems, sized to displace the annual kWhs of a mixed-fuel home

There are several Exceptions, including:

- Shading due to external barriers
- Building plans approved prior to 1/1/2020
- Variance for multi-story buildings with limited roof space





PV Exceptions

Exceptions to part or all of the proposed residential PV requirement:

- EXCEPTION 1 : Address where existing barriers external to the dwelling exist, including but not limited to trees, hills, and adjacent structures
- EXCEPTION 2 : Allow for a reduced PV size in climate zone 15 if there is restricted solar access at the site, 1.5 w/sf of CFA
- EXCEPTION 3 : Allow for a reduced PV size for single family homes with two stories, 1.0 w/sf of CFA
- EXCEPTION 4 : Allow for a reduced PV size for single family homes with three or more stories, 0.8 w/sf of CFA
- EXCEPTION 5 : Allow masterplans approved by planning departments prior to January 1, 2020, even if permit is pulled after the effective date
- EXCEPTION 6 : Allow for a reduction of 25% in PV size if installed in conjunction with a battery storage system of at least 7.5 kWh capacity.

These are not complete Exceptions language, please refer to Standards for full text



PV Size

Right sized PV systems coupled with grid harmonization strategies work better for the grid, environment, and home occupants than larger standalone systems.

The average PV size required by the standards is **2.8 kW**.

By comparison, the average existing home PV installation is **7.2 kW**. PV sizes vary with house size and climate zone.

PV Sizes for Mixed Fuel Homes. 2700 SF Prototype

1	2	3	4
CZ	Efficiency EDR without PV, based on 2019 Efficiency Measures	Target Design Rating Score for Displacing kWh Elect with PV	kW PV Size for Displacing kWh Electric Only
1 - Humboldt	48.0	26.5	3.4
2 - Santa Rosa	41.2	18.0	2.9
3 - San Francisco	46.9	22.7	2.8
6 - Costal LA	48.0	20.9	2.9
7 - San Diego	48.0	14.9	2.7
8 - Disneyland	43.0	14.6	2.9
11- Redding	43.3	23.4	3.8
12 - Sacramento	43.1	24.5	3.1
13 - Fresno	44.8	22.1	4.0
14 - Palmdale	44.6	21.3	3.4
15 - Palm Springs	48.0	17.9	5.7
16 - Tahoe	46.3	27.5	3.0



PV Cost Effectiveness

- All Standards measures, including efficiency and renewables, must be cost effective using life cycle costing (LCC)
- Comply with NEM sizing rules (NEM right-sizing) and compensations rates – Offsetting the annual kWh of the building, overgeneration compensated at wholesale ~ 3 cents/kWh
- PVs are NEM right-sized to displace annual kWhs are found to be cost effective in all 16 climate zones





Options for PV Installations

The building Standards allow different options for meeting the PV requirements:

- Rooftop installation
 - Outright purchase – larger initial investment by home owner, larger monthly savings
 - Lease and PPA options – little or no initial investment, smaller monthly savings
- Community Solar – If and when approved and become available, will be an alternative to rooftop PVs





Community Shared Solar/Renewables

Community Solar - Section 10-115 – Include shared PV and Battery Storage systems

Homes can instead be served by Commission approved community solar projects that provide equivalent benefits to the homes as onsite PV systems.

1. CS resources may include other shared renewables like wind and geothermal
2. Energy Performance – As if it is a rooftop PV systems
3. Energy savings dedicated to building for 20 years NOT occupants
4. Cost Savings – Cannot cost the occupants more than non-participants
5. Durability – Dedicated to the building for at least 20 years, like rooftop PVs
6. Additionality – CS resources must exclusively serve the building and not other buildings or purposes





Electric Water Heating

- Single Dwelling System
 - 2 Prescriptive heat pump water heater options
 - Separate Performance baseline for gas and electric
- Multifamily Central System
 - Prescriptive and Performance pathway for split-system (Sanden)
 - Allow PV tradeoff in place of solar thermal requirement
 - CEC currently working to include additional systems/configuration



Energy Budget

The Energy Budget for newly constructed residential buildings is now expressed as an Energy Design Rating (EDR),

- Energy Efficiency EDR,
- Solar Electric Generation and Demand Flexibility EDR
- Combined to arrive at Total EDR

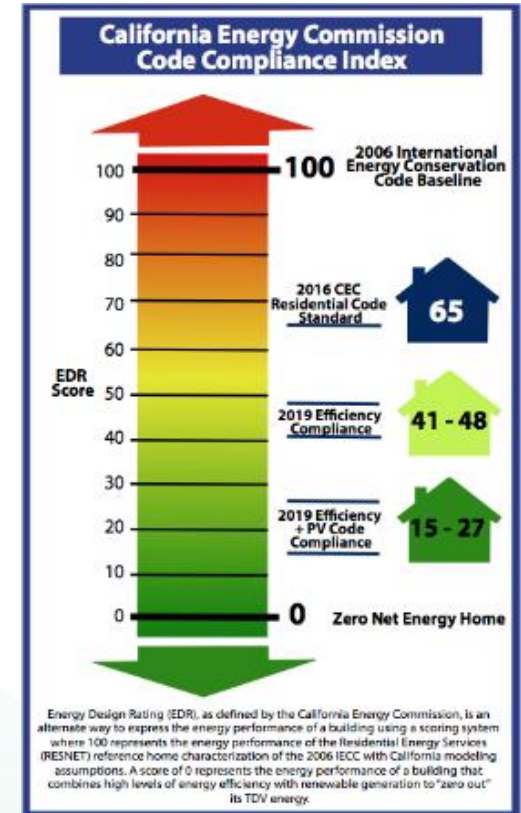
Energy Budget for additions and alterations, and nonres continues to be expressed as TDV energy



Energy Design Rating

Energy Design Rating (EDR) score show how close a home is to the ZNE target

- Aligned with RESNET
 - Reference home is a 2006 IECC compliant home, EDR=100
 - A score of zero means a ZNE building
- CEC's CBEC-Res software has the capability to calculate EDR scores for EE and PV
 - EDR approach provides ultimate flexibility to achieve compliance
 - Builders can use a combination of envelope energy efficiency features, storage, demand response, better appliances, PVs, and other strategies to get to the target EDR





EDR Example

2019_CZ12_2700ft2_Std_ELEC - CZ12 STD2700 EGLASS20 ELEC

Compliance Summary | CO2 Emissions | **Energy Design Rating** | Energy Use Details | CO2 Design Rating

EDR of Standard Efficiency: **48.1** - EDR of Standard Design PV: **18.7** = Final Std Design EDR: **29.4**
 Std Design PV: 3.17 kW (not current)

EDR of Proposed Efficiency: **46.8** - EDR of Prop PV + Flexibility: **43.8** = Final Proposed EDR: **3.0**

End Use	Reference Design Site (kWh)	Reference Design Site (therms)	Reference Design (kTDV/ft ² -yr)	Proposed Design Site (kWh)	Proposed Design Site (therms)	Proposed Design (kTDV/ft ² -yr)	Design Rating Margin (kTDV/ft ² -yr)
Space Heating	5,107		56.05	2,273		25.01	31.04
Space Cooling	1,645		61.06	353		20.06	41.00
IAQ Ventilation	194		2.28	194		2.28	0.00
Other HVAC			0.00			0.00	0.00
Water Heating	2,924		34.29	1,030		11.14	23.15
Grid Harmonization						0.00	0.00
Photovoltaics				-9,416		-95.35	95.35
Battery				318		-19.94	19.94
Inside Lighting	2,615		34.79	616		8.01	26.78
Appl. & Cooking	2,596		31.59	2,135		26.07	5.52
Plug Loads	3,146		38.73	2,371		28.73	10.00
Exterior	328		4.15	152		1.87	2.28
TOTAL	18,555		262.94	25		7.88	255.06

Done



Energy and CO₂ Savings

Residential – For Single Family Homes:

- Average 30-year cost of \$9,500 and Savings of \$19,000
- Monthly mortgage increase of \$45 and energy bill reduction of \$80
- Energy savings of 7% without PVs and 53% of entire house with PVs

Percent Savings Between 2005 and 2019 Standards Cycles

Statewide Average	Residential Energy Savings	Residential CO ₂ e Reduction
	68%	52%

Nonresidential: LED lighting will save > 480 gigawatt-hours in the first year

Combined: The efficiency improvements save over 650 GWh for all buildings, enough to power 250,000 electric cars



Questions?





NEM Rules

Net Energy Metering (NEM) has many different complicated facets, but for building Standards the most important elements are:

1. NEM compensation rules for self-use, hourly exports, and annual overgeneration
2. NEM sizing rules that limits retail compensation rates (or close to it) to only the kWh that do not exceed the annual house load
3. NEM interconnections - rules for direct wired and virtual connections between panels and buildings, including single and multifamily, and commercial buildings

Future NEM revisions may change these rules, including the compensation rules for the hourly exports. In California the CPUC sets the NEM rules

