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## NRDC comments on 8-22-2017 staff workshop on EDR PV Storage in 2019 code

*Additional submitted attachment is included below.*


# Staff Workshop on Residential Solar Photovoltaic, Storage, the Energy Design Rating and Grid Integration Impacts for the 2019 Building Energy Efficiency Standards

September 1, 2017

The Natural Resources Defense Council (NRDC) appreciates the opportunity to comment on the California Energy Commission (CEC)'s Staff Workshop on Residential Solar Photovoltaic, Storage, the Energy Design Rating and Grid Integration Impacts for the 2019 Building Energy Efficiency Standards on August 22nd, 2017.

The 2019 Building Energy Efficiency Standards are an important policy tools to help California implement its climate and energy goals, and a milestone toward these goals. By requiring that the annual electricity use of residential homes is offset by on-site solar generation, the 2019 code is a major step toward zero net energy (ZNE) and very low carbon buildings.

NRDC strongly supports the commission's efforts and direction on this proceeding, and offers the following comments.

## Energy Efficiency Measures

NRDC strongly supports CEC's "efficiency-first" approach, where buildings must first meet the Energy Efficiency Energy Design Rating (EE EDR) first, without credit for additional photovoltaic (PV) beyond code requirement, and must then meet a final EDR score including the contribution of PV. Efficiency has some inherent advantages over renewable energy, which is one reason that the loading order places it first.

This will end the temporary PV credit, which was established in 2016 as a trade-off to help the building industry transition to high-perf envelopes (walls, attics, windows, doors, and quality insulation installation). With the 2019 code about to require PV on every home (with limited exceptions), and with the transition to high-performance envelopes well underway with many builders having already adopted it as standard practice, **it is essential that the PV credit ends by 2020 to make high-performance envelopes standard building practice in California**. This is important because envelope efficiency remains critical to achieving the deep decarbonization of buildings needed to meet our climate goals. PV by itself, for all its benefits, cannot alleviate summer evening peak demand after sunset, or winter morning demand before sunrise. And PV has a cost advantage over efficiency for the near-term future, as it qualifies for tax credits that are unavailable

to efficiency measures, it benefits from favorable Net Energy Metering export compensation, and it also is easier to finance as a standalone measure. Therefore, we strongly believe it is time for new homes to meet the EE EDR score without a PV credit.

The 2019 Standards should require the most efficient envelope measures available (walls, attic, windows and doors), including the proposals to strengthen requirements for high-performance walls (HPW), attics (HPA), and windows and doors, and to prescriptively require quality insulation installation (QII). High-performance envelope measures last largely for the life of the building, whereas PV, storage and other flexibility measures do not, notwithstanding all their benefits. Envelope efficiency is also much easier to include in a home during initial construction, as retrofitting homes with better-insulated walls, for example, requires invasive construction work and is much costlier than installing HPWs from the outset. In contrast, solar is easier to retrofit if the wiring is already present.

In addition, the proposed 2019 code does not offset non-electric energy use such as natural gas use for space and water heating. As such, California should maximize energy efficiency measures to offset all possible non-electric fuel use. California utilities are also facing a growing challenge of grid load ramping up quickly as home and grid-scale PV production drops in the evening, even though cooling demand is still high particularly in late summer days. Grid operators are often meeting this fast-changing load with inefficient, more carbon intensive natural gas peaking plants and imports. In line with California's carbon emissions reduction goals, new homes should be built to be as efficient as possible to minimize this effect.

As noted in the CASE Reports, California's Energy Action Plan of 2003 requires that cost-effective efficiency measures be prioritized over additional generation capacity. Since the 2019 Standards approach ZNE and include mandatory requirements for on-site renewable energy generation, all cost-effective efficiency measures should be required.

**Raise the mandatory minimum insulation levels to require continuous exterior insulation**

The Commission established mandatory minimum wall and ceiling insulation levels several decades ago based on a simple logical observation: empty stud spaces are cheap and easy to insulate during construction and expensive to retrofit. Insulation is extremely cost effective, and there were no imaginable circumstances under which trading away insulation for other efficiency measures would make sense for the home dweller. The Commission may also have considered radiant temperature and moisture control issues: an uninsulated envelope element would have low surface temperatures during the heating season that would be uncomfortable and could condense water vapor.

We now know much more about building science, and realize that envelope elements need to be protected not only from condensation on the inner surfaces when it is cold outside, but also from internal condensation or even high humidity; we also know that structural elements outside the insulated surface are subject to wider temperature swings, which lead to expansion and contraction

and increased risk of decay and failure. The best way to do this is to provide a significant portion of the insulation in the form of a continuous insulation layer (that may also serve as an air barrier and a moisture barrier) outside the structural layer.

This issue has been discussed on an almost monthly basis in the ASHRAE Journal by Joe Lstiburek, and the main points are summarized in: Joseph Lstiburek. "The Perfect Wall". BSI-001: Building Science Insights, published by Building Science Corporation, July 15, 2010. https://buildingscience.com/documents/insights/bsi-001-the-perfect-wall[1].

Thus, NRDC recommends that the Commission increase minimum mandatory R values (and possibly construction types) that follow the recommendations of modern building science that ensure the durability and freedom from moisture-caused mold and dry rot based on a minimum R-value of continuous insulation placed over a conventionally insulated frame wall or ceiling. We note that these recommendations are not based primarily on direct energy savings but rather on health and structural longevity, as well as thermal comfort.

**Solar Photovoltaic (PV) Prescriptive Requirement**

NRDC strongly support requiring 100% offset of the building's projected annual electricity use (for mixed fuel buildings) through rooftop or community-based solar PV (distributed generation). This is an important contribution to the state's renewable electricity and GHG emissions reduction goals, and distributed generation avoids transmission investments and gives customers access to lower cost electricity, which enables further reductions in GHG emissions by making electrification of gas end uses more affordable.

**Exceptions and Alternates**: We urge CEC to narrowly and clearly define exceptions to the solar requirement, to minimize the number of exceptions.

We also encourage CEC to establish alternate requirements that ensure that buildings that are not suitable for solar PV don't get a free pass. NRDC recognizes that not every building is suitable for PV, such as buildings shaded by trees or other structures. However, the lack of any alternate requirement would provide a strong incentive for abuse of the exception process and potentially

[1] This source notes that: " If we put the insulation on the inside of the structure the insulation does not protect the structure from heat and cold. Remember we really do want to protect that darn structure—especially for the sake of making the structural engineers life more happy. Expansion, contraction, corrosion, decay, ultra violet radiation, and almost all bad things all are functions of temperature. So all the control layers go on the outside. Keep the structure from going through temperature extremes and protect it from water in its various forms and ultra violet radiation and life is good…In a beautiful bit of elegance and symmetry if you lie the perfect wall down you get the perfect roof."

lead to loopholes. Alternate requirements will ensure that buildings that are not suitable for solar PV still do their fair share for energy savings and carbon reductions, for example through community solar, higher efficiency, or grid flexibility. We suggest the following alternate requirements (one of the following).

1. Community solar, under conditions discussed in the next section;
2. Mandatory envelope performance measures including HPA, HPW, QII, and windows and doors, that cannot be traded off for other measures;
3. Air tightness: require 3 ACH50[2] with HERS testing. Air tightness reduces infiltration, keeping the heat out in summer and cold out in winter, reducing heating and cooling loads, and increasing the demand flexibility potential of homes;
4. Higher efficiency HVAC and hot water equipment, including zoned heat pump/ACs with full[3] demand control capability
5. Grid flexibility measures, such as battery, pre-cooling, and grid-connected electric water heating.

These options are not subject to preemption because they are compliance options, not the prescriptive baseline in the code. At least one of them needs to be cost-effective, which several of them are, and potentially all of them.

**Solar PV Siting and Alternative Renewable Requirements**

NRDC supports flexibility regarding where the solar array dedicated to the home is located, and what renewable energy is procured to achieve the 2019 code's EDR requirements, as long as this renewable energy has the same or greater benefits as those of rooftop solar. Flexibility can help achieve California's objective of a decarbonized energy system more quickly and more rapidly than prescriptive rooftop PV siting requirements.

However, we need to ensure that this renewable energy is real and has the same or greater benefits than if it were located on the roof. We agree with CEC's criteria that off-site renewable energy supplied to the home s be additional, quantifiable, verifiable, and durable. We think it should also be relatively local so that it has similar transmission cost avoidance benefits to distributed generation, and it should have similar customer financial benefits to ensure cost-effectiveness and bill savings,

[2] Air changes per hour under 50 Pa pressure
[3] By "full" we mean the ability both to change the timing of load through storage that pre-cools or heats and also defers cooling or heating, AND the ability to absorb excessive generation usefully and efficiently.

and to make decarbonization measures such as electrification of space and water heating accessible to homeowners.

There is no certification program that guarantees these requirements in California to date. We support CEC's proposal to establish an application process for local jurisdictions to create community solar programs, but encourage CEC to not limit this process to local jurisdictions, as those may not have the resources to develop such programs. Other entities may be interested in developing and administering them, and the CPUC might also help develop such programs. CEC should leave this option as open as possible, and encourage initiative and innovation in developing off-site renewable programs that achieve equivalent benefits to rooftop solar. CEC need only set principles that need to be considered and a review process to validate proposals, so that the building code is compatible with potential future initiatives.

**Grid Harmonization / Flexibility Measures**

NRDC appreciates and strongly supports CEC's emphasis of grid harmonization such as battery storage, pre-cooling and grid-connected electric water heating, as it begins to require on-site renewable energy generation.

Grid flexibility is an essential strategy for achieving deep emissions reductions in the buildings sector. It is therefore important for the code to appropriately value such capabilities.

NRDC supports the principle of valuing grid flexibility in a manner that sends a meaningful market signal, while not jeopardizing key efficiency measures and particularly high-performance envelopes.

NRDC believes that valuing grid flexibility only on the PV EDR score does not provide a strong enough incentive for these measures. The amount of PV to be installed on homes isn't a strong driver for builders, because customers—or the builder-often finance PV separately and are more willing to pay for PV than for less visible efficiency measures. In addition, grid harmonization increases PV cost-effectiveness and could lead builders and customers to want to increase rather than decrease the size of PV on their home, so an option to reduce PV size may not be seen as a meaningful incentive by many.

One option could be to waive the effect of the orientation of the home on the compliance score: homes that have more windows on one side than the others will see their EDR score vary significantly depending on the orientation of the home. For production builders who may design model homes independently of their orientation, the orientation penalty forces them to design for worst case orientation. Waiving this orientation effect would allow them to design model homes without worrying about orientation. This could provide a more meaningful incentive than the PV EDR score.

**Electric Baseline**

NRDC strongly supports CEC' indication at the workshop that it will provide independent compliance path for both mixed-fuel and all electric homes. However, implementation is critical to ensure this is effective. We urge CEC to implement this independent path both prescriptively and in the performance path.

Currently, the main obstacle to building all-electric homes in California is the lack of independent compliance path for electric water heaters. They are compared with instantaneous gas water heaters. This disadvantages electric water heaters, as even high-performance heat pump water heaters (NEEA Tier 3 certified) are given a significantly higher compliance score than the prescriptive instantaneous gas water heater, despite using lower source energy and being responsible for much lower GHG emissions. As a result, builders have to offset the water heater compliance deficit with other measures, which increases the cost of the building.

To truly level the playing field, the code should compare electric water heaters to a NEEA Tier 3 baseline. NEEA Tier 3 guarantees high-efficiency, while leaving flexibility for both higher or lower efficiency models through the performance path.

An electric baseline matters not just for code compliance, it matters for programs that are based on the EDR score, such as the California Advanced Homes Programs (CAHP), which provides incentives to builders. The use of the gas baseline currently makes it difficult for all-electric homes to qualify for this program.

**Accounting for gas connection costs in cost-effectiveness**: If the commission chooses to keep a single baseline in the compliance path, then it should account for the cost of connecting the building to gas. Comments by Stone Energy Associates docketed after the April 20, 2017 workshop show that such costs can run in the thousands, as high as $14,000 in one case. If these costs were accounted for, CEC would probably find all-electric homes to be more cost-effective than mixed-fuel homes, as the cost of gas connection would offset the higher first costs, and operational costs would be lower.

**Model Ordinance for Renewable Water Heating Compliance Option in 2016 Reach Code**

ON May 5, 2017, NRDC and twelve other stakeholders including Acterra, Association for Energy Affordability, CALSEIA, City of Berkeley, Carbon Free Palo Alto, Design AVEnues LLC, Home Energy Analytics, MenloSpark, Sanden International, Sierra Club, Sonoma Clean Power, Stone Energy Associates, and Union of Concerned Scientists, filed joint comments asking CEC to add a "renewable water heating" option to its solar PV model ordinance. This would allow local jurisdictions to consider both options, and either adopt the solar PV ordinance alone or both options together depending on their situation and priorities.

CEC's proposal aims to offset most of the electricity use in a dual-fuel building, but it does not address the energy used by thermal end uses such as water heating and space heating. Direct use of fossil fuels, primarily natural gas, for thermal end uses in residential buildings is responsible for a roughly equivalent amount of GHG emissions in California as all electricity used in these buildings.[4]

This is an overlooked opportunity to save energy and reduce GHG emissions, as several technologies are available today that can provide significantly lower-carbon hot water in buildings than with current natural gas systems. These include electric heat pump water heaters (HPWH), and solar thermal water heating.

We ask CEC to approve this renewable water heating model reach code as soon as possible to facilitate its adoption by local jurisdictions who are looking for leadership opportunities to cut GHG emissions from energy use in buildings. This will also help develop the market for HPWH statewide, increasing the adoption of the advanced electric water heating option in the 2020 code.

We appreciate the opportunity to provide this input, and thank CEC for its careful consideration of our comments.

Respectfully submitted,

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[4] Jones C., Kammen D., "Bay Area Consumption-Based Greenhouse Gas Emissions Inventory", Jan. 2016, http://www.baaqmd.gov/research-and-data/emission-inventory/consumption-based-ghg-emissions-inventory