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NRDC Comments on the 2019 Title 24 Draft Time Dependent Valuation of Energy Updates
Docket #16-BSTD-06
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On behalf of our over 2 million members and online activists, 250,000 of whom are in California, the Natural Resources Defense Council respectfully submits the following comments on the CEC's draft update to the Time Dependent Valuation (TDV) of Energy metric for the 2019 Title 24 Building Energy Standards.

The Title 24 Building Energy Standards assure that all new buildings and renovations in California meet minimum levels of efficiency, providing cost-effective energy savings for Californians, reducing energy demand, and cutting greenhouse gas emissions. NRDC has participated in the proceedings to develop Title 24 since its inception because of these important consumer and environmental benefits. Title 24 has saved Californians over $30 billion on their energy bills since the first standards were adopted in 1975, in addition to cutting the associated pollution emissions.[1] These benefits do not even include the value of increased comfort in new homes, nor the benefits of decreases in gas and electricity prices that result from reducing demand.

The TDV metric has been used since 2005 and is the underlying metric both in the development of and to determine compliance with the Title 24 Building Energy Standards. The TDV metric is fundamentally a consumer-cost metric, but is adjusted hourly (for electricity) and monthly (for gas) to reflect the time value of energy saved. The rationale behind this is to create a metric that captures the time-variation in the cost of providing energy, such that, for example, the value of reducing a kilowatt-hour during a peak summer day is greater than in the middle of a winter night. These values are used both to determine the cost-effectiveness of measures under consideration for each update to the Title 24 Building Energy Standards and for compliance with the standard itself, by comparing the TDV energy use of the proposed design to that of a reference building.

NRDC generally supports the purpose of TDV: to capture the time variation in energy cost. *However, we continue to have strong concerns that the TDV metric as currently structured does not adequately capture the long-term cost of greenhouse gas emissions reductions needed to meet California's emission reduction goals.* This is an issue that we commented on throughout the 2016 Title 24 development process and has not been resolved. *The CEC should address this issue this code cycle by modifying the*

[1] http://www.energy.ca.gov/releases/2013_releases/2012_Accomplishments.pdf

reference home to use the same fuel type for water heating as the proposed design. We offer detailed comments on this issue below.

Putting aside this overarching concern, we have general comments on the proposed changes to the 2019 TDV methodology. In general, we support the CEC's proposal to update the TDV inputs to be "SB 350 friendly." We also have comments on the way the proposed TDV values will affect different load types and on the variation in emissions values used for the electric TDV values. We offer detailed comments on these issues below.

Comments

The current TDV values do not adequately capture the long-term cost of greenhouse gas emissions reductions and are an insufficient metric for determining fuel choice in buildings. The proposed TDV values for electricity are much higher than those of natural gas. Because gas is the baseline fuel for water heating and sometimes space heating, this results in a bias in the code towards gas end-uses and makes it very difficult to install electric equipment in both new construction and retrofits. This is true even though emissions from electricity are declining in California. Because of this, electric space and water heating equipment can have lower emissions than gas equipment.

While the proposed TDV values do include an emissions price, this price does not reflect the long-term abatement cost of achieving an 80 percent reduction in greenhouse gas emissions by 2050. Greenhouse gas emission prices factored into TDV are far from sufficient to achieve CA's goal of 80 percent greenhouse gas emissions reduction by 2050. Per the E3 analysis for CA principals[2], this goal will require either an almost complete electrification of natural gas end uses in buildings, that the current TDV approach prevents, or an almost complete decarbonization of natural gas, which would likely be far more expensive than accounted for in greenhouse gas emission prices included in the TDV values. Currently, the driver of the overall TDV values is the retail rate projections –the TDV values are built up from many components and then adjusted upward with a retail rate adder to meet retail rate projections. The drivers of the TDV hourly shape are transmission and distribution and capacity costs. The value of emissions is very small compared to these other costs and it varies minimally by time of day, so that, while emissions contribute to the TDV values as currently constructed, their effect is minimal – at the end of the day they are effectively washed out by the retail rate adjustment.

The result is TDV values for electricity that are much higher than for those of gas, primarily driven by the difference in retail rates. Across all climate zones, on average the electricity TDV values are 3.8 times those of gas. Even at the lowest cost hour for electricity, the TDV value of electricity is still 2.3 times more costly than that of gas (occurs in climate zone 16). And in the highest cost hour, the TDV value for electricity is 123 times that of gas (occurs in climate zone 4). Figure 1 shows how the levelized TDV values for electricity and gas compare across the 16 climate zones over the course of the year.[3] As can be seen from the chart, generally the electric TDV values are about 3-4 times that of gas. For many hours of the year the difference is even greater, with these peak differences concentrated in the summer and fall

[2] https://ethree.com/public_projects/energy_principals_study.php
[3] TDV values were converted to a common denominator of site BTU for the purpose of comparison. The graph shows electricity TDV values for each hour of the year divided by those of natural gas, for each climate zone, after this common denominator adjustment was made.

months. The large differences in electric and gas TDV values persist across all of California's climate zones.

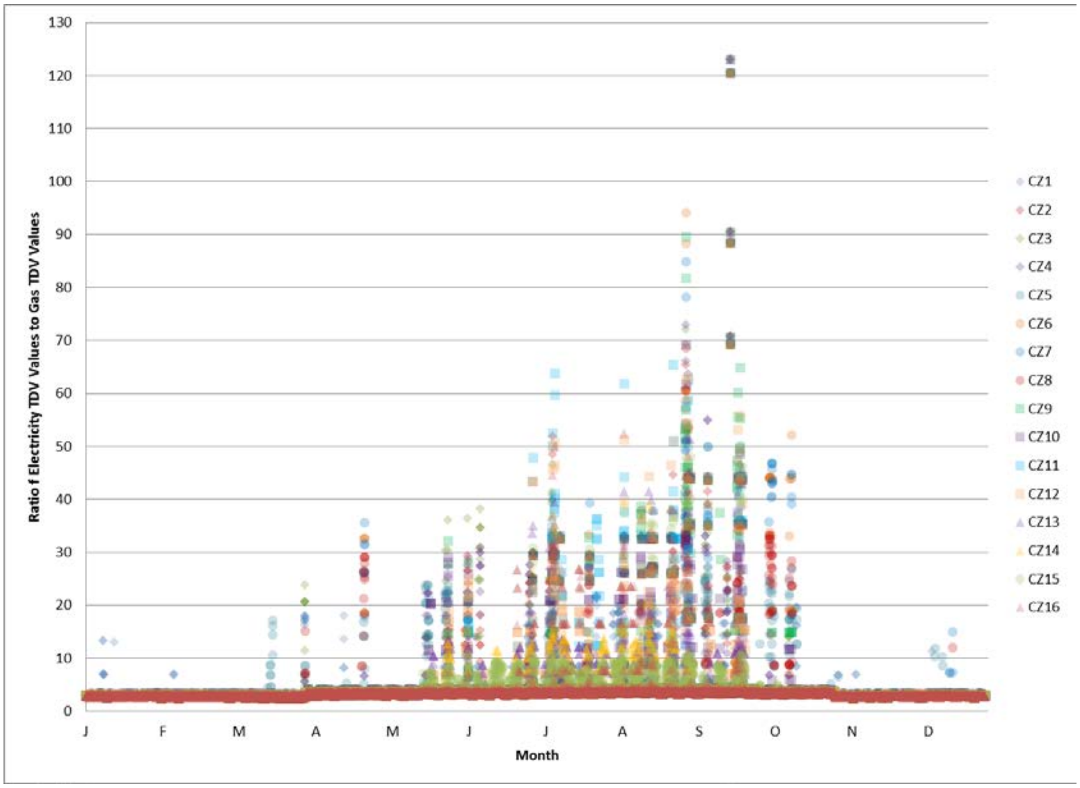

Figure 1: Ratio of 2019 proposed electricity TDV values compared to gas TDV values.

This large difference in electricity and gas TDV rates is significant because gas is used as the baseline fuel in many instances in the Title 24 Building Energy Standards. This is an issue for residential water heating in both new construction and retrofits, as well as space heating in retrofits. Figure 2 illustrates this issue. Figure 2 shows the average annual emissions and TDV energy use from water heating use in a prototype home modelled in CBEC-Res 2013 in five California climate zones. The emissions scenarios considered are described in detail in Appendix A. As can be seen from the chart, while only the most efficient heat pump available beats the TDV baseline set by a tankless gas water heater, all heat pump water heaters have lower emissions under the "best estimate" emissions scenario.

In summary, the TDV methodology should be changed to better reflect the full cost of achieving 80 percent emissions reductions by 2050. Incorporating these costs would be consistent with California's policy and more realistically account for the full cost of achieving emissions reductions. *If the CEC is unable to modify the TDV values to reflect this full cost, the CEC should address this issue by using the same fuel type in the reference home as in the proposed design.* This would mean that homes using gas appliances would be compared to a gas home baseline and homes using electric appliances would be compared to an electric baseline. For water heating, we recommend using a minimum standard 55 gallon electric water heater as the baseline for homes that use electric water heating.

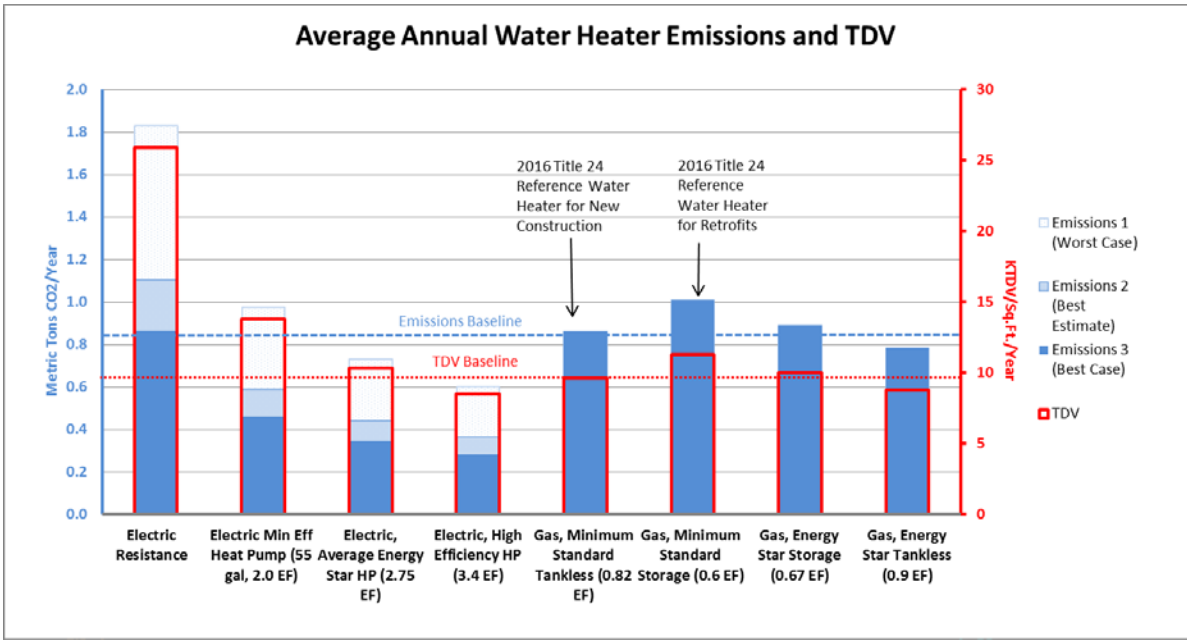

Figure 2: Comparison of average annual emissions and TDV energy use for water heating in a prototype home modeled CBECC-Res 2013.

NRDC supports the proposed "SB350 friendly" updates to the 2019 TDV Values. The CEC has proposed to update the 2019 TDV values with what it calls "SB 350 friendly" assumptions in its base case; namely, incorporating a 50 percent renewable portfolio standard by 2030 and a doubling of the 2015 IEPR Additional Achievable Energy Efficiency by 2030.We support these updates to the base case.

NRDC recommends that the CEC do further analysis on how the resulting TDV values affect various building loads. The CEC has proposed changes to the T&D methodology which have the effect of making the electricity TDV values "peakier": concentrating the peak TDV values into fewer hours and making these peaks higher. These changes also shift the peak electric TDV values later for most climate zones. While we think the shift to a later peak is directionally correct, we are concerned that the increase "peakiness" of the TDV values could overemphasize certain hours in a way that implies greater certainty in the exact future peak hours than is humanly possible to predict. We understand that E3 is continuing to make updates to the T&D methodology. As part of this, we recommend that they conduct a more in depth analysis of how the updated TDV values affect different load types than what was presented in the May 12, 2016 workshop. Specifically, E3 presented a preliminary analysis of the energy used by cooling and lighting using the 2013 compared to 2016 TDV values. Looking at how the values affect different building loads will provide a way to truth check the TDV values and gauge whether the increased peak TDV values give reasonable results when used to analyze individual building end-use loads. We recommend that the CEC expand on this building load analysis once the T&D updates to TDV have been made.

CEC should ensure that the emissions values used for the electricity TDV values accurately reflect the daily profile of resources likely over the next 30 years. Figure 3 shows the average daily profile of the emissions cost adder for Climate Zone 12.[4] While there is a dip in the cost per kilowatt-hour derived from emissions between 8 and 3 PM, it is small and does not appear to reflect the share of resources operating during these hours over the next 30 years that will be zero emission resources. The CEC should evaluate whether the emissions component of the electricity TDV values adequately reflect the share of zero emissions resources in the resource mix for each hour of the day over the next 30 years.

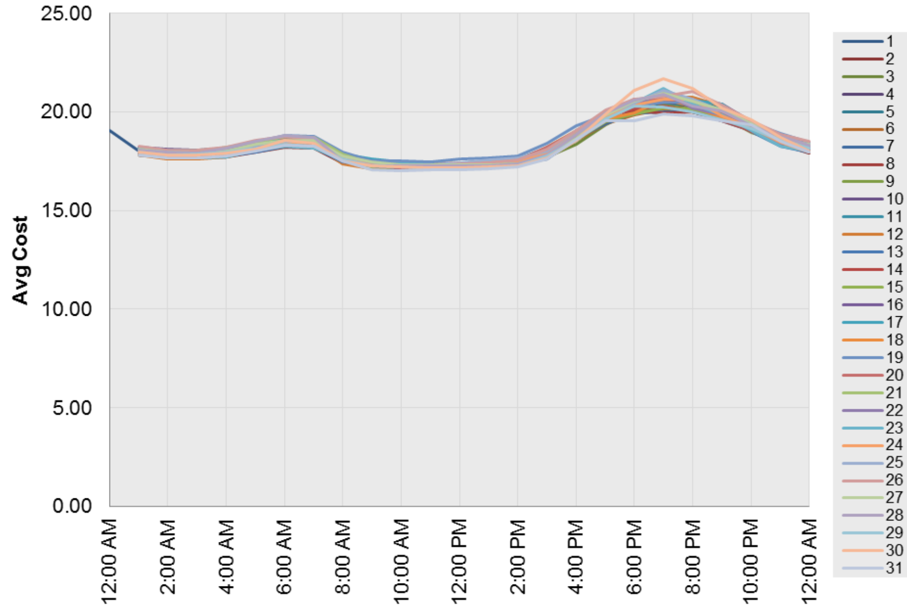

Figure 3: Average daily profile of emissions cost component of residential electricity TDV values in Climate Zone 12.

CEC should fully account for the cost of gas infrastructure upgrades and incidents. The natural gas TDV values do not appear to include the costs of gas infrastructure upgrades for safety and leakage mitigation that will be necessary over the next 30 years. They also do not appear to include any costs associated with incidents and major leakage events, such as the recent leak at Aliso Canyon. These costs should be fully accounted for in the natural gas TDV values.

We appreciate the opportunity to submit these comments and would welcome the opportunity to discuss any of these issues further.

Sincerely,

Meg Waltner
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Natural Resources Defense Council

[4] The graph reflects the whole year of values, but the shape of the profile does not change significantly from month to month.

Appendix 1

Determining the appropriate emissions rate to use when comparing natural gas versus electric equipment over the long-term is a complex question. To the extent this equipment contributes to peak-load, the appropriate rate would be that of the marginal peak-resource. However, when considering increased penetration of electric equipment, the obverse question should be asked: what is the resource that will be built to serve the increased load. It is common, when analyzing the long-term impacts of a change in load, to use the expected variable costs of the resource likely to be built if the energy efficiency were not put in place.[5] In California, the effect of the renewable portfolio standard (RPS) must also be considered when determining what resource will be built to meet this additional load.

It is unclear how much the electrification of water and space heating will contribute to peak load versus base load. Water heater time of use in particular is highly variable and is specific to each household. Existing data shows that water heating loads tend to peak in the mornings with a secondary peak in the evening, but data is limited.[6] Residential heat pump electricity usage tends to correlate to outdoor air temperature and has a flatter load profile than electric resistance water heaters.[7] Both space and water heating also have the potential to be a grid-interactive and/or scheduled load, with water heaters offering particularly promising ability to load shift.[8]

Due to the uncertainty in the emissions rates, this analysis looks at three electricity emission scenarios. First, the analysis develops two emissions rates: one for new load added on peak and the other for new load added off peak. The on-peak rate assumes that the marginal resource at peak is a conventional turbine peak natural gas plant, but that for every kilowatt-hour added on peak, renewables must be added off peak to meet the RPS, thereby offsetting the emissions of the base off-peak resource: a combined cycle natural gas plant. An RPS of approximately 40 percent is considered, which is California's average RPS between 2020 and 2030, a conservative estimate for the lifetime of equipment potentially affected by the results of this analysis. The off-peak rate assumes that new off-peak load will be met with combination of a new combined cycle natural gas plant and a 40 percent RPS. [9] All emissions factors assume distribution and transmission system losses of 11 percent.[10]

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[5] See, for example, National Action Plan for Energy Efficiency, Understanding Cost-Effectiveness of Energy Efficiency Programs, November 2008, Table 4-2.

[6] Hledik R., J. Chang, and R. Lueken. 2016. The Hidden Battery: Opportunities for Electric Water Heating. http://c.ymcdn.com/sites/www.peakload.org/resource/resmgr/ Research/TheHiddenBattery.pdf

[7] Boait P. and A. Stafford. 2011. Electrical Load Characteristics of Domestic Heat Pumps and Scope for Demand Side Management .

[8] Hledik R., J. Chang, and R. Lueken. 2016. The Hidden Battery: Opportunities for Electric Water Heating. http://c.ymcdn.com/sites/www.peakload.org/resource/resmgr/ Research/TheHiddenBattery.pdf

[9] It is reasonable to assume that the plants that will be built to serve this new load are a combination of combined cycle gas plants, which provided 67% of California's natural gas generation in 2013, and whose electricity output grew by 230% between 2004 and 2013 (Thermal Efficiency of Gas Fired Generation in California: 2014 Update, California Energy Commission, CEC-200-2014-005, September, 2014)

[10] See: Comparison of Loss Factors, A Review of Transmission Losses in Planning Studies, August 2011, California Energy Commission, CEC-200-2011-009, p. 24; Derived from in-state and import line loss factors assuming 30% imports.

Table 3: On and off-peak emissions rates.

	Description	Emissions Rate
On-peak	A blended rate of 60% single-cycle and 40% combined-cycle[11]	0.55 kg CO2/kWh
Off-peak	A blended rate of 60% combined-cycle and 40% RPS	0.26 kg CO2/kWh

These rates were combined into three different scenarios. Scenario 1 represents a worst case scenario: 100 percent of added load is on-peak. It is extremely unlikely that this scenario would occur in the real world, because as discussed above, the usage patterns of space and water heating equipment is variable. Furthermore for heat pump water heaters and space heating equipment, this scenario is likely a physical impossibility as there are not enough peak hours to match the number of hours per day that this equipment runs. Therefore, scenario 1 represents a conservative bookend, primarily relevant for electric resistance equipment. Scenario 2 is characterized as the best estimate and is meant to reflect a load that is naturally distributed evenly between off- and on-peak use and then is partially controlled to shift 25 percent of load off-peak. Scenario 3 is characterized as the best case: 100 percent of load is off peak.[12]

Table 3: Emissions Scenarios Analyzed

	Description	Emissions Rate
Scenario 1 (Worst Case)	Uncontrolled, 100% on-peak	0.55 kg CO2/kWh
Scenario 2 (Best Estimate)	Partially controlled, 25% on-, 75% off-peak	0.33 kg CO2/kWh
Scenario 3 (Best Case)	Controlled, 100% off peak	0.26 kg CO2/kWh
Natural Gas	Direct-use of natural gas	5.31 kg CO2/therm

[11] As described in the text, this blended rate reflects the RPS.
[12] Notably, a true best case would control some portion of the load to match the availability of zero emissions resources and so would be even better than anticipated here.