**Comments of the Natural Resources Defense Council (NRDC) on the Final 2013 Integrated Energy Policy Report (IEPR)**

**Docket 13-IEP-1A**

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## [redacted]I. Introduction

The Natural Resources Defense Council (NRDC) appreciates the opportunity to offer comments on the “Final 2013 Integrated Energy Policy Report” (Final IEPR). NRDC is a nonprofit membership organization with a long-standing interest in minimizing the societal and environmental costs of providing the reliable energy services that Californians demand. We represent our nearly 80,000 California members’ interests in receiving affordable energy services and reducing the environmental impact of the state’s energy consumption.

NRDC appreciates the ongoing effort of the California Energy Commission (CEC) staff to address the numerous energy issues facing California and applauds the overall focus of the draft IEPR on increasing energy efficiency and meeting renewable energy targets. We provide comments on a select number of chapters and recommend that the Commission adopt the Final 2013 IEPR with the following additional suggestions.

## [redacted]II. Forecast of California Energy Demand

1. ***We commend the CEC and the joint agencies for their collaboration throughout the year on forecasting energy efficiency. We commend the CEC and joint agencies for agreeing on a reasonable, though conservative, single statewide managed forecast to be used for system resource planning, but urge the CEC to publish that statewide managed forecast next to the currently published forecast that excludes Additional Achievable Energy Efficiency (AAEE).***

We appreciate the CEC’s work, along with the California Public Utilities Commission (CPUC) and California Independent System Operator (CAISO), to coordinate work on energy efficiency issues throughout the year. For the joint agencies to arrive at agreement on a single statewide managed forecast is a major accomplishment and we commend the joint agencies for doing so.

We also commend the Commission and joint agencies for including a reasonable, though conservative, amount of future Additional Achievable Energy Efficiency (AAEE, previously known as “uncommitted”) in that managed statewide forecast.[1] In previous IEPRs, the CEC had

[1] “The recommendation is to use the mid base case forecast in combination with the mid additional achievable

acknowledged that future energy savings (called "uncommitted" then) were reasonably expected to occur.[2] However, this Final IEPR marks a departure from previous cycles because this cycle's Final Forecast 2014-2024 included additional achievable energy efficiency,[3] and the Final IEPR includes the "Mid" case AAEE in the agreed upon statewide managed forecast. This is a significant improvement from previous cycles, for which we commend the agencies.

However, we urge the CEC to insert an actual figure representing this statewide managed forecast in the Final IEPR, which currently contains no graph of the agreed-upon statewide managed forecast. We recommend placing the figure for the managed forecast next to the current Figure 5 on page 86, which shows a forecast without any AAEE. In its current format, having the IEPR only show a forecast that excludes all AAEE presents a misleading view of the forecast for actual consumption. Additionally, being able to compare a statewide forecast with and without future AAEE serves the valuable purpose of documenting the difference that continued energy efficiency makes. Therefore, in addition to commending the CEC, its staff, and its sister agencies for including a reasonable amount of AAEE savings in the agreed upon statewide managed forecast, we urge the Commission to actually publish a figure of that forecast, not just the forecast that omits the AAEE.

### 2. *We also appreciate the CEC's and staff's disaggregating the forecast results in order to facilitate resource planning processes at ISO and the CPUC.*

We also appreciate the CEC's expanding how it reports its forecast in order to facilitate resource planning processes at ISO and the CPUC. Throughout this IEPR cycle, the CPUC's potential study, and various Demand Analysis Working Group meetings, it became apparent that resource planners required greater granularity in the both the base demand forecast results and the AAEE forecasts: "Stakeholders have expressed a strong interest in a more disaggregated demand forecast to better inform resource and infrastructure-related analyses and decisions. As a first step in this direction, staff developed results at the climate zone level for CED 2013 Final in

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energy efficiency scenario for system wide planning for the 2014-2015 procurement and transmission planning cycles." Final IEPR, p. 8.

[2] "[R]reasonably expected to occur initiatives have been split into two types: committed and uncommitted." CEC, *California Energy Demand 2010-2020 Adopted Forecast*, p. 28 (December 2009). CEC, *California Energy Demand 2012-2022 Final Forecast*, p. 32 (June 2012).

[3] "CED 2013 Final includes three baseline scenarios designed to capture a reasonable range of demand outcomes over the next 10 years. . . . Staff also developed estimates of additional achievable energy efficiency impacts for the investor-owned utilities that are incremental to (do not overlap with) committed efficiency savings included in the CED 2013 Final baseline scenarios." Final Forecast, p. 1.

addition to the usual utility planning area forecasts."[4] We appreciate this first step and look forward to working with staff in future venues in order to ensure that resource planners also have disaggregated AAEE forecasts.

### 3. *We agree with and urge the Commission to work with the joint agencies over the next year to improve local forecasting (and planning) of energy efficiency impacts (and programs) in order to arrive at more reasonable estimates of efficiency for local resource planning purposes, and are encouraged that the CEC will continue to collaborate on this subsequent work that may take part in other venues.*

We agree with the Commission and joint agencies that they should work toward improving the resource planners' abilities to incorporate reasonable amounts of energy efficiency into local forecasts. While there are currently nuanced differences between incorporating system and local resource efficiency impacts, the goal is to arrive at a reasonable amount of energy efficiency at the local level as well as the state level, as the IEPR states: "To be able to converge on the same AAEE scenario for all studies in the future, the agencies are collaborating to create more geographically-specific, local-area disaggregation and load-shape impact methods."[5] Thus, we support the joint agencies proposal: "In future planning cycles, the agencies will collaborate to make improvements in the baseline demand forecast and additional achievable energy efficiency forecasts for use in local studies."[6] We note that a significant portion of the work in local resource planning and energy efficiency program planning may take place at the CPUC, and so are encouraged that the CEC will continue to collaborate with the joint agencies on these shared issues.

### 4. *We recommend that the CEC include all reasonably expected to occur energy savings in subsequent IEPR demand forecasts.*

The CEC should include all reasonably expected energy savings in its final demand forecast because it impacts the decisions in long term infrastructure planning, as the CEC recognized in its February 2013 commitment: "[The joint agencies] agree that it is crucial to appropriately and consistently consider energy efficiency savings in energy forecasting, electricity procurement planning, and transmission planning to avoid over- or under-building the electricity infrastructure

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[4] *California Energy Demand 2014-2024 Final Forecast Volume 1*, p. 9 (September 2013).
[5] Final IEPR, p. 93
[6] Final IEPR, p. 8.

. . . ."[7] This IEPR cycle, the CEC and joint agencies had an inaugural year of collaboration on efficiency work, and made great strides compared to previously. However, the total amount of energy efficiency included in the Final Mid AAEE case was overly conservative (see NRDC Comments on the Final Forecast[8]). Some reasons were due to conservative assumptions in the CPUC's Potential Study; however, one significant assumption was squarely within the CEC's purview: the amount of energy efficiency expected from Publicly-Owned Utilities (POU) in California. POUs report their ten-year energy efficiency targets directly to the CEC, and the CEC received these targets in March 2013. However, the CEC excluded nine out of ten years' worth of POU energy efficiency savings in the Final Mid AAEE case. In the next IEPR, we urge the Commission to include POUs' ten year targets in the estimates of AAEE, and to work toward including all reasonably expected to occur energy efficiency in the Final Forecast.

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[7] B. Weisenmiller, M. Peevey, S. Berberich, *Letter to the Honorable Alex Padilla and the Honorable Jean Fuller*, p. 1 (February 28, 2013).

[8] NRDC, *Comments of the Natural Resources Defense Council and Sierra Club on the California Energy Demand 2014 – 2024 Final Forecast* (December 2013).

## [redacted]III. Zero-Net-Energy Buildings

1. ***We recommend the CEC modify the language in the Zero-Net-Energy Buildings section of the IEPR, as suggested below, to ensure that it is consistent with the intended purpose of the codes.***

***ZNE Code Building requirements***

The Final IEPR draft states that ZNE Code Building requirements will be established "with reasonable exceptions." (p. 25) We note that "exceptions" to the codes will ultimately make them less effective in achieving their intended purpose of reducing energy use in the most economic manner possible. We recommend that the Commission replace "exceptions" with "tradeoffs."

The word "exception" implies that we are letting the builder get away with something; whereas the word "tradeoffs" implies that builders all still have to meet the same energy savings goal, but can do so in different ways. Therefore we propose that over the next code cycle update, the Commission create tradeoff options with construction energy and transportation, which are not very challenging to create and would achieve the intent of the current language.[9] In addition, we recommend that "code" be struck from the second sentence noted below since any grid issues associated with ZNE buildings would be relevant whether the action is due to code or choice. We suggest the following language changes:

- p. 25: "Recognizing that all buildings require a pathway to compliance, it would be necessary to establish ZNE Code Building requirements with reasonable ~~exceptions~~ <u>tradeoffs</u> to account for building and building site limitations <u>and the savings of supply chain energy enabled by remodeling existing buildings and employing recycled or reused construction materials."</u>

In addition, we encourage the CEC to immediately begin working with stakeholders to reach an agreement on exactly how calculations should be done to determine the various "tradeoffs" for code purposes (e.g. in other words, how is location efficiency calculated in a way that is in comparable units to TDV energy? i.e., what is the ACM for location efficiency and construction energy? Please refer to the attached article as a starting point). As noted above and

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[9] See Attachment B: "A New Net Zero Definition: Thinking outside the Box" David Goldstein, Jamy Bacchus. <u>Proceedings of the 2012 ACEEE Summer Study on Energy Efficiency in Buildings</u>. Washington D.C.: American Council for an Energy-Efficient Economy, 2012.

in Attachment B, there are already methodologies for calculations of transportation and construction energy that can serve as a starting point.[10] For internal loads, the Commission can start with ANSI/RESNET Standard 301 and modify if needed for California purposes.

We suggest the following language changes:

- p. 25: Other issues requiring further discussion include, but are not limited to, quantifying the role of transportation energy, housing density, and land use in the ZNE context to allow tradeoffs to occur with consistency as to calculation methods and results; the availability and refinement of electricity and natural gas system information and costs used to update TDV; revisions to "plug load" assumptions; and the effect of ZNE ~~Code~~ Buildings on the operation of the electricity grid.

***Efficiency of plug loads and appliances***

We recommend the following language be included to ensure coordination with national efforts:

- p. 24: "The increasing number of plug loads in buildings highlights the crucial role of appliance standards in achieving ZNE Code Buildings. The ZNE Building Code Building determination will be based on "typical" levels of portable "plug load" equipment. The current "plug load" assumptions are in Chapter 4 of the Home Energy Rating System (HERS) Technical Manual. These values should be compared with those of ANSI/RESNET Standard 301, so that the Commission and RESNET can together evaluate their reasonableness.

***2. We strongly urge the CEC to adopt an energy performance index in place of the Energy Use Intensity (EUI) metric.***

As we emphasized in our previous comments, it is extremely difficult to develop specific EUI targets that would be applicable across a range of vastly different building types and levels of energy services. Specifically, EUIs vary with a number of factors that have never been included in codes previously, including:

- Building size (e.g., heating loads and cooling loads vary differently from each other as house size changes; while water heating and plug loads in lighting vary in yet different ways)
- Footprint of the building (e.g., square versus long and narrow versus complex shapes)
- Number of stories
- Construction method and choice of material (e.g., concrete versus wood frame versus steel frame versus insulated concrete form versus straw bale, etc.)

[10] For example, see Attachment B: "A New Net Zero Definition: Thinking outside the Box" David Goldstein, Jamy Bacchus. Proceedings of the 2012 ACEEE Summer Study on Energy Efficiency in Buildings. Washington D.C.: American Council for an Energy-Efficient Economy, 2012.

- Building type (e.g., single family detached, attached, and multifamily)
- Different tenant needs in what is ostensibly the same type of building, such as office or retail: (e.g., commercial lighting can use a tailored approach or a whole-building approach, with the former recognized by current Title 24 as varying a lot depending on whether the tenant needs)
- Ducted systems versus hydronic or VRF; duct static pressure needs and ventilation needs
- Orientation; shading by adjacent structures
- Location of the water heater; hot water pipe diameter, run length and plumbing geometry
- Climate variations

The factors above cause an EUI approach to depart significantly from economic optimality.[11]

Furthermore, there is clear precedent for why an EUI metric should *not* be used. The past attempts of using an EUI metric during the 1980s for the Title 24 commercial code and in the proposed Building Energy Performance Standards (BEPS) by DOE in the 1970s proved to be inadequate and were both ultimately abandoned. Before pursuing this path, we strongly urge the CEC to evaluate these two previous attempts at using EUIs. This evaluation would be useful not only to the CEC but throughout the world: papers are often published on how policy successes were achieved, but failures are seldom documented. The findings from this assessment should be publicly available and used to inform next steps.

As a more practical metric, we recommend an energy performance index or asset rating that uses the current Title 24 system of comparing the proposed design to a reference building that meets the energy code as of some specified date, since it normalizes for occupancy types and level of energy service.

[11] This issue is discussed in Goldstein and Eley, “A Classification of Building EnPIs” *Energy Efficiency*, publication forthcoming, copies available shortly from NRDC.

## [redacted]IV. Utility Progress toward Achieving Energy Efficiency Targets

1. ***We urge the CEC to set statewide goals for energy efficiency as a top priority item in the 2014 IEPR update and commence conducting the comprehensive AB 2021 report with all deliberate speed.***

California has shown great success in capturing energy savings through our efficiency policies over the past four decades. The IEPR recognizes that the CEC is required "develop statewide energy efficiency potential estimates and targets for California's publicly owned and investor-owned utilities" per AB 2021. However, the final draft states, "the Energy Commission plans to address the statewide goal for energy efficiency in the next IEPR" (p. 28).

We strongly recommend the CEC prioritize setting statewide energy efficiency goals by working expeditiously on the AB 2021 report. We recommend the CEC produce, as a top priority item in the IEPR update, an estimate of statewide energy efficiency potential and a best estimate for utility targets for the next ten years because it is an essential component of the landscape of California's energy future. Additionally, prioritization of this AB 2021 report is warranted because the CEC is already behind the due date dictated by state law, that the CEC produce its statewide goal by November 1, 2013.[12]The CEC has already received and analyzed data from the vast majority of POUs' annual energy efficiency report and CPUC's 2013 Energy Efficiency Potential Study. Energy efficiency targets are crucial in guiding policies and scaling up energy efficiency. Thus, the CEC should not delay any further and set statewide goals in order to ensure California can achieve its state energy and climate goals.

2. ***We recommend the CEC set strategies to work with public-owned utilities and assist them in capturing all potential cost-effective energy efficiency, and reinsert the language from AB 2021 documenting the responsibility of POUs to conduct ten-year efficiency potential studies.***

POUs have played an important role in helping CA save energy. However, in recent years, POU energy savings and investments have been leveling off. We commend the CEC's commitment "to [encourage] and [assist] the POUs to increase the scale of cost-effective

[12] "On or before November 1, 2007, and by November 1 of every third year thereafter, the commission in consultation with the Public Utilities Commission and local publicly owned electric utilities, in a public process that allows input from other stakeholders, shall develop a statewide estimate of all potentially achievable cost-effective electricity and natural gas efficiency savings and establish targets for statewide annual energy efficiency savings and demand reduction for the next 10-year period." Cal. Public Resources Code § 25310.

investments in energy efficiency through creativity and good program models" (p. 36). We urge the CEC to include specific recommendations in the final IEPR for supporting POUs to ensure that they will be on track to meet their targets. As a critical starting point, we recommend that the CEC conduct a transparent analysis of the POU cost-effective energy efficiency potentials and further explore strategies to help POUs meet their targets.

We also urge the CEC to correct the description of AB 2021, which was removed in the current version of the IEPR. The removed language on page 28 of the Final IEPR stated:

- P 28: "Under AB 2021, POUs are directed to identify all potentially achievable cost-effective electricity savings; establish annual targets for energy efficiency savings and demand reduction for the next 10-year period;" and went on to describe two other main responsibilities of POUs under AB 2021: to provide an annual report to the CEC and to conduct annual independent EM&V.

In the current Final IEPR, that quoted language has been struck, modified, and reinserted in the paragraph above as: "With the passage of AB 2021, POUs joined the IOUs in being required to provide a forecast of energy efficiency savings." (And then goes on to describe the other two main responsibilities.) This modified language obscures the purpose of AB 2021 and the specific responsibility placed on POUs—to actively conduct ten-year efficiency potential studies—not just to provide a report. State statute makes clear that "By March 15, 2013, and by March 15 of every fourth year thereafter, each local publicly owned electric utility shall identify all potentially achievable cost-effective electricity efficiency savings and shall establish annual targets for energy efficiency savings and demand reduction for the next 10-year period."[13] Therefore, we recommend that the Commission reinsert the original language on page 28 of the Final IEPR as such:

- P. 28: "~~With the passage of AB 2021, POUs joined the IOUs in being required to provide a forecast of energy efficiency savings~~ Under AB 2021, POUs are directed to identify all potentially achievable cost-effective electricity savings; establish annual targets for energy efficiency savings and demand reduction for the next 10-year period."

We look forward to working with the CEC, POUs, and their representative organizations over the coming years to ensure that POU potential studies are comprehensive and timely, as California POUs help the State reach its energy and climate goals, and many POUs set leadership examples for utilities around the country.

[13] Cal. Public Utilities Code § 9505(b).

### *3. We recommend the CEC affirm the importance of evaluation, measurement, and verification (EM&V) in the language of the IEPR, according to NRDC and NCPA's agreement submitted to the CEC this year.*

We commend the CEC's commitment to assist POUs in their EM&V efforts and to improve EM&V guidance for POUs to make the EM&V process more transparent. As the IEPR suggests, supporting EM&V efforts are important as "a means to increasing energy efficiency effectiveness" (p. 31). The current language undermines the value of understanding and assessing the impacts of efficiency programs, which is critical in guiding future programs and policy actions. Therefore, we encourage the CEC to make the following modification to the language to reflect the importance of evaluating and reporting energy efficiency achievements (deletion = ~~strikethrough~~; insertion = *italics*):

- p.31: "This consolidation will streamline the process and allow the POUs to ~~focus their resources on implementing efficiency programs rather than on~~ more easily report~~ing~~ their savings."

Additionally, we recommend that the IEPR language reflect the importance of POUs conducting independent EM&V and the fact that AB 2227 did not change the original EM&V requirements contained in AB 2021, pursuant to NCPA and NRDC's agreement, which was submitted to the CEC this year and attached hereto as Attachment B. Specifically, NCPA and NRDC agreed that: "Nothing in AB 2227 and the amendments to PU Code Section 9505 are intended to change the original requirements of AB 2021 with regard to these EM&V analyses and reports. . . . Because the intent of AB 2227 was not to change anything substantive from the previous version of the PU Code, annual submittals of the results of independent EM&V analyses are still required, consistent with the provision of AB 2021."[14] Therefore, we recommend that the IEPR reflect this agreement on EM&V annual reporting requirements by inserting the already agreed upon language into page 28 of the IEPR which discusses AB 2227's effects on POUs. Specifically, on page 28, in the second-to-last paragraph, immediately after the sentence ending with "…POUs will provide updated targets every four years rather than every three, as was originally required by AB 2021" we recommend inserting the following sentence

- P. 28: "Because the intent of AB 2227 was not to change anything substantive from the previous version of the PU Code, annual submittals of the results of independent EM&V

[14] NCPA/NRDC, Letter to CEC and Commissioner McAllister, *Re: NCPA and NRDC Joint Statement Regarding Evaluation of Energy Efficiency Programs and AB 2227*, p. 2 (April 3, 2013). Attached hereto as Attachment C.

analyses are still required, consistent with the provision of AB 2021."

### *4. We recommend the CEC correct the description of challenges that POUs face with cost-effectiveness calculations.*

We strongly recommend the CEC modify language in the IEPR to correctly reflect the description of cost-effectiveness as applied to POUs. Cost effectiveness of energy efficiency programs is determined by the total costs and total benefits of running the programs. These costs include that of the utility to administer programs and costs of customers' investments, depending on the type of cost-effectiveness test used. Benefits include the monetary benefits of the energy and supply-side resources avoided due to the programs. While differences in regulatory structures between IOUs and POUs result in some differences in the calculations, differences in revenue structure and financial structure do not impact the cost-effective calculations. Therefore, we strongly recommend that the CEC amend the following erroneous sentence:

- P. 30: "Cost-effectiveness is ~~difficult to compare~~ sometimes calculated differently between POUs and IOUs both because of the differences in their regulatory~~, financing and revenue~~ structures and for lack of data about cost-effectiveness inputs for individual POUs".

## [redacted]V. Procurement/SONGS

1. ***We recommend that the CEC uphold its commitment to the State's Loading Order by removing statements that it will seek to replace SONGS with gas-fired generation before using all cost-effective and achievable energy efficiency.***

We urge the CEC to adopt an IEPR report that upholds the priority of energy efficiency and preferred resources in this Commission's Energy Action Plan and the State's Loading Order. The State's Loading Order established in the EAP II identifies energy efficiency as the state's top priority resource.[15] State law codifies this policy and requires that any procurement need must be met first with efficiency.[16] The State also established that energy efficiency should explicitly be considered a resource to maintain grid reliability.[17] It is clear from State law and the joint agency Action Plan, that this Commission must pursue *all* cost-effective and reliable energy efficiency *before* procuring any supply-side resources.

However, the IEPR currently makes statements contrary to the Loading Order by advocating that SONGS should be replaced by a minimum of 50% gas-fired generation, even if there is cost-effective, achievable, energy efficiency that could meet the need. These statements contravene the State's Loading Order, are arbitrary percentages, and have significant consequences for communities in Southern California that will incur the health costs of building 50% gas-fired generation in their neighborhoods. We incorporate by reference the joint environmental letter previously submitted, entitled "Comments on the Final 2013 Integrated Energy Policy Report and the Preliminary Reliability Plan" and attached hereto as Attachment A. We recommend that the Commission remove references that support the 50/50 procurement split because it contravenes state energy policy.

Specifically, the IEPR should strike and modify the following sentences:

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[15] "As stated in EAP I and reiterated here, cost effective energy efficiency is the resource of first choice for meeting California's energy needs. Energy efficiency is the least cost, most reliable, and most environmentally-sensitive resource, and minimizes our contribution to climate change." CPUC/CEC, *Energy Action Plan II,* Implementation Roadmap for Energy Policies (October 2005). Available at: http://docs.cpuc.ca.gov/published/REPORT/51604.htm.
[16] "The electrical corporation shall first meet its unmet resource needs through all available energy efficiency and demand reduction resources that are cost effective, reliable, and feasible." Cal. Public Util. Code § 454.5(b)(9)(C).
[17] "Energy efficiency investments . . . help improve system wide reliability by reducing demand in times and areas of system congestion, and at the same time reduce all California electricity users' costs. These investments also significantly reduce environmental costs associated with California's electricity consumption, including, but not limited to, degradation of the state's air, water, and land resources." Cal. Public Util. Code § 399(e)(3).

- P.9: "The agencies are committed to seeking ~~50 percent of the incremental resource need from~~ *all cost-effective and feasible* energy efficiency, demand response, distributed generation, and storage *to meet the incremental resource need*.
- P. 9: "The CPUC will implement its decision, as part of its Long Term Procurement Plan proceeding, to replace San Onofre capacity and new load growth with ~~50 percent~~ *all cost-effective and feasible* preferred resources ~~and 50 percent~~ *before procuring* conventional resources.
- P. 33: "Initiatives consistent with the AB 758 Action Plan should also become a critical component of California's efforts to replace San Onofre with ~~50 percent~~ *all cost-effective and feasible* preferred resources *that can meet the resource need* (for further discussion, see Chapter 4).

## [redacted]VI. Conclusion

NRDC appreciates the opportunity to comment on the draft 2013 IEPR and recommends that the Commission adopt the 2013 IEPR with the inclusion of the aforementioned recommendations.

# Attachment A

**<u>Via electronic mail</u>**

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 13-IEP-1A
1516 Ninth Street
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**Re: Comments on the Final 2013 Integrated Energy Policy Report and the Preliminary Reliability Plan**

The Sierra Club, Communities for a Better Environment, California Environmental Justice Alliance, Clean Coalition, Environmental Defense Fund, Asian Pacific Environmental Network, The Vote Solar Initiative, and the Natural Resources Defense Council submit the following comments on the Preliminary Reliability Plan for Los Angeles Basin and San Diego ("Preliminary Reliability Plan" or "Plan") and its reference in the Final 2013 Integrated Energy Policy Report ("Final 2013 IEPR"). Due to the significant impacts of new gas plants on California's clean air and climate goals and the lack of need for new authorizations of fossil-fuel generation to maintain grid reliability, we ask that the Preliminary Reliability Plan not be approved, that the Commission remove all references in the IEPR that could be construed as an endorsement of the Plan, and that the Commission help work toward a 100% preferred resource solution to meet any need resulting from the retirement of the San Onofre Nuclear Generating Station ("San Onofre"), as the evidence shows is feasible.

When the Preliminary Reliability Plan was first issued, significant concerns were expressed that the Plan's proposed 50/50 split of fossil fuel and preferred resource procurement to address the retirements of San Onofre and once through cooling ("OTC") facilities in Southern California was an arbitrary and flawed rush to judgment.[1] Because

[1] *See, e.g.*, Joint Comments of NRDC, Sierra Club California, EDF and CEJA on the Joint Workshop on Southern California Electricity Infrastructure and Reliability Issues, Sept. 23, 2013,

the Plan's proposed procurement solution was based on preliminary analysis that had yet to be robustly vetted as part of the need assessment in the Long Term Procurement Proceeding ("LTPP") at the California Public Utilities Commission ("CPUC"), any declaration of purported procurement needs following the retirement of San Onofre was premature. In addition, the Plan failed to properly account for reduced energy demand projections, the expected deployment of preferred resources, and viable transmission solutions that would substantially reduce the need for new local conventional generation.

Because San Onofre was an emissions-free energy source, replacement with carbon-intensive generation will undermine California's air quality and climate goals. Indeed, following the shutdown of San Onofre, greenhouse gas pollution from in-state electricity generation rose 35 percent due to increased use of gas-fired power plants, part of which is due to the closure of SONGS.[2] New fossil-fuel procurement would also send the wrong signal to other regions of the country and world also grappling with replacement of nuclear plants. Fortunately, with the LTPP evidentiary process now concluded at the CPUC, it is clear that additional gas-fired power plants are not needed to maintain grid reliability.

The Commission's most recent demand forecast both significantly reduces energy demand in Southern California and substantially increases the savings most likely expected from anticipated energy efficiency measures.[3] Accordingly, future energy needs are much less than assumed by the Preliminary Reliability Plan. In addition, proper accounting of anticipated progress in California's investments in distributed (rooftop and small scale) solar, energy storage, and demand response further reduce the need for new generation.[4] To the extent that need still remains, it can be filled with additional targeted deployment of these resources. If necessary, transmission improvements can also reduce the need for new gas-fired generation in the LA Basin. For example, the Mesa Loop-In project proposed by SCE to upgrade an existing

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http://www.energy.ca.gov/2013_energypolicy/documents/2013-09-09_workshop/comments/Joint_Environmental_Comments_2013-09-23_TN-72012.pdf. While the Reliability Plan purported to opine on reliability needs resulting from the retirements of San Onofre and OTC plants, need resulting from OTC retirements had already been fully analyzed and addressed by the Public Utilities Commission and resulted in an authorization of 1,000 -1,200 MW of gas-fired generation. The only remaining question is how to meet any need resulting from the retirement of San Onfore.

[2] California Air Resources Board, 2208-2012 Emissions for Mandatory Greenhouse Gas Emissions Reporting Summary (Nov. 4, 2013) (showing increase in in-state greenhouse gas emissions from 30,732,214 metric tons in 2011 to 41,610,182 in 2012 and attributing change to increase in use of natural gas as fuel due to decrease in hydroelectric generation and loss of San Onofre), *available at* http://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/2008-2012-ghg-emissions-summary.pdf.

[3] Depending on the outcome of a review of how energy demand is allocated in and outside the LA Basin, the Mid-Case Final Demand Forecast in the 2013 IEPR projects between 461 and 1,321 less need in the La Basin and SDG&E service territory than the 2012 IEPR relied on by the Preliminary Reliability Plan. In addition, Mid-Case energy efficiency savings would further reduce demand by 2,107 MW, over twice the 1,000 MW of energy efficiency savings assumed in the Reliability Plan. Mid-case savings are based on conservative assumptions and are defined as "most likely" to occur.

[4] For example, under a recent CPUC decision, SCE and SDG&E are collectively required to procure 745 MW of energy storage by 2020. Guiding principles for procurement include "optimization of the grid, including peak reduction." To maximize value of energy storage to ratepayers and avoid costly overprocurement of gas-fired plants, a significant portion of the energy storage requirement can and should be targeted and designed to meet peak capacity needs.

substation would reduce generation need in the LA Basin by up to 1,200 MW – the equivalent of two new mid-size gas plants.

Given the Preliminary Reliability Plan's significant flaws it should not be used as a reference to inform decision-making on San Onofre replacement. Accordingly, the Commission should remove statements in the Final 2013 IEPR that can be construed as an endorsement of the Plan. For example, page 9 states:

> The CPUC will implement its decision, as part of its Long Term Procurement Plan proceeding, to replace San Onofre capacity and new load growth with 50 percent preferred resources and 50 percent conventional resources. Also, the CPUC will make timely decisions regarding approval of power purchase agreements for capacity.

It is not the role of the Energy Commission or the IEPR to prejudge outcomes of the CPUC's independent authority to determine procurement needs. This sentence should be removed from the IEPR. For the same reason, the sentence on page 181 stating that "The closure of San Onofre in 2012 requires some replacement generation from a combination of natural gas and preferred resources" should also be removed. Similarly, page 33 states:

> Implement the Action Plan for the Comprehensive Energy Efficiency Program for Existing Buildings. The Energy Commission plans to adopt its final Action Plan for the Comprehensive Energy Efficiency Program for Existing Buildings in late 2013. The Action Plan and future year updates should become a core component of the California Long Term Energy Efficiency Strategic Plan and the Scoping Plan for AB 32, the Global Warming Solutions Act of 2006. *Initiatives consistent with the AB 758 Action Plan should also become a critical component of California's efforts to replace San Onofre with 50 percent preferred resources.* [emphasis added]

While we support adoption of a comprehensive energy efficiency action plan, the last sentence should be removed. It is unnecessary and improperly endorses the Reliability Plan.

Now is the time for California to lead on clean energy and clean air. We have an opportunity to demonstrate that deployment and proper accounting of efficiency, clean energy and infrastructure upgrades can fully address reliability issues resulting from the closure of the San Onofre nuclear facility. Rather than endorse the unsubstantiated 50/50 procurement proposal, we strongly urge the Commission to help ensure California meets any need resulting from the retirement of San Onofre using 100% preferred resources.

Thank you for your consideration of these comments. We look forward to working with the Energy Commission to help build a clean energy future for California.

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Angeline Galiteva, Director, California Independent System Operator
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## Attachment B

# A New Net Zero Definition: Thinking outside the Box

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**ABSTRACT**

Zero net energy (ZNE) definitions focus on metered fuel and electricity use. This is due in part to simplify the calculation, but also due to a lack of understanding and accepted methodology for calculating other energy-related impacts. This paper compiles the best approaches to assess a meaningful measure of true net zero energy, which includes, along with fuel and electricity used on-site, transportation energy related to the building location, material usage and its embodied energy, and water consumption and its embedded energy.

If ZNE goals are to reduce absolute energy consumption, then this broader scope will assure ZNE implementation doesn't inadvertently shift building energy usage onto other sectors.

To assess the impact of building location on energy use there needs to be a method for calculating transportation energy use related to occupants, employees and visitors. Methods for reviewing residential transportation energy use, i.e., location efficiency, exist at the census tract level. Commercial building related travel requires different calculations factoring: business type, labor and customer distribution, taxes and competition.

Buildings use materials that require energy due to extraction and processing. The reuse of existing materials or structures can prevent the creation of new materials. Energy simulations can predict the materials' impact on operational energy, while life cycle analysis can appraise the materials' embodied energy.

Buildings use water for potable and process functions. Water requires pumping, filtration, treatment and disposal. The paper will review methods to determine water consumption and its embedded energy, which is likely regionally dependent.

This paper will assess gaps in data needed to conduct this type of complete analysis for commercial or residential projects and make recommendations for filling these absences in data.

## Introduction

The goal of zero net energy buildings has moved rapidly from a broad philosophical aspiration to a set of real and implementable policies. California, for example, has set a goal of net zero by 2020 for new residential construction and net zero by 2030 for new commercial construction. In 2012, the state adopted new energy code proposals that are broadly consistent with the goal. The 2012 standards represent the largest triennial-cycle improvement in the code in the state's history. Although the residential standards fall somewhat short of a track leading to net zero by 2020, the commercial standards suggest that the 2030 net zero goal may be met ahead of schedule.

As a part of this process, the state (California) is beginning to address the issues of **avoiding the error of suboptimization—**in which savings in the performance of the *utility energy using portion of a building*'s *impact* compromises the *ability to save energy in other energy end uses* also associated with the building.

The issue of avoiding suboptimization was raised in Goldstein 2010, and the state is beginning a process of developing specific recommendations on how to calculate net zero energy use that respond to those concerns.

This paper begins by reviewing the issues, explaining what steps California has taken to address them in principle, and then discusses how one might move to metrics that address full system[1] optimization that could be implemented immediately (within a year). It then describes evaluations of these metrics to show how much of a difference they would make using some prototypical development patterns intended to represent realistic choices that builders could make.

## Avoiding Suboptimization

Energy use by utilities in a typical American home is about 108 MBTU (31.6 MWh) per year of source energy (Jonathan Rose Companies 2011), and costs the typical household $2500 a year. Reducing on-site energy, again with a source metric, to net zero evidently reduces both usage and operating costs to zero[2].

But the typical analysis of the cost-optimal path to achieve net zero requires that roughly 30% of current energy use be supplied by on-site solar electricity. This expectation requires collector areas that make high rise developments infeasible, especially for commercial buildings, and in general limits the density of development, especially when one considers the issues of shading.

But density is a prime determinant of transportation energy use. For an average household, personal transportation consumes 80-90 MBTU/yr (23-26 MWh/yr) and costs about $10,000/yr. If reaching net zero utility energy on a given site increases transportation energy use by even a tenth[3] as much (proportionally) as the incremental renewable energy not generated, then society is behind on a cost basis. The EPA funded study by Jonathan Rose Companies 2011 found that conventional home construction and conventional car ownership had lower overall energy use compared to a low-energy home and hybrid car when the energy efficient home was in a typical suburban development and the average home was transit oriented.

Suboptimization is also possible if low energy use comes at the expense of greater water use or greater embodied energy in construction. For example, if a complete teardown and reconstruction allows utility energy to meet the net zero concept, but deep retrofit and reuse still allows 80% savings, which option is better? A recent study by the National Trust (Frey 2012) found that it can take 10 to 80 years (depending on type of construction and climate) for a new building that is 30% more efficient to overcome the negative climate change impacts related to construction compared to a renovated existing building.

Many regions in the southwest are arid, which makes evaporative cooling effective in offsetting vapor-compression based air conditioning to reduce electricity consumption and peak demand. These same regions also have water scarcity issues and contain water utility districts

[1] Since this paper is about energy policy, we define "full system" to include the four energy-related parameters described herein. One could also optimize more broadly for other environmental needs, such as considering the value of water as higher than just its energy content, or for reducing nonrenewable use of wood, reducing supply chain water and air emissions impacts, etc.

[2] Zero net source energy does not exactly equal zero net cost, depending on how on-site generation is treated in the ratemaking process, how time of use rates mirror the effect of calculating source energy, and many other factors. But this assumption is good to first approximation, in that it is not evident what the sign of the correction term would be.

[3] Remaining utility energy after 70% efficiency savings is about $750 a year, compared to $10,000 for transportation

which may be pumping fresh water supplies over vast distances. If achieving net zero is done on the back of water use, then the result is largely a shell game where the boundary is redrawn beyond the property's lot line and considered at a community level. ***The simple way to avoid suboptimization is to expand the definition of the metric to be optimized so that it embraces all of the relevant variables.***

What this demands is an index of total energy impact of a home or a commercial building that embraces the energy consequences of all four attributes: operations, transportation, water and materials.

This process can be done in the immediate future for the larger parameters, particularly if we are willing to live with some uncertainty for a time. The next section demonstrates current levels of preparedness for such a move, what steps must be taken, and how they could be taken.

## Implementing Total Net Energy Metrics

There are four well-developed parameters that we suggest need to be evaluated. Additional parameters should be included as they are judged to be of policy interest and as the methodology in calculating them matures. This section reviews that status of methodologies for doing so.

### Utility Energy

There are now well-developed methods in the North America[4] for evaluating utility energy use based on building design and independent of knowledge not available when the building permit is issued on how the building will be used and operated.

California's energy code provides methodologies for both residential and commercial buildings that project average energy consumption—that is, energy consumption assuming standardized operating conditions--and these methods are used in code compliance by 98% of homes and 70-80% of commercial buildings that include envelope compliance (Gabel 2012). Parallel methods to estimate energy use globally (but with emphasis on North American conditions) are available from Residential Energy Services Network (RESNET) and Commercial Energy Services Network (COMNET) (RESNET 2012 and COMNET 2011). These standards were developed through an informal consensus process and will be submitted to a formal American National Standards Institute (ANSI) consensus process in 2012.

These evaluation methods, known as asset ratings, have been shown to predict measured energy use well for a cohort of buildings (Hassel, Blasnik & Hannas 2009). The correlation with measured use for individual buildings is expectedly weaker as variations in usage and operation make it impossible for a test standard to predict individual results (Goldstein 2010).

### Source Energy

California evaluates energy use in terms of "Time Dependent Valuation" (TDV) which is a system that weights individual units of gas or electric consumption by the relative cost of each fuel at each hour of the year and in each of California's 16 climate zones. It can be considered a form of source energy, but since the metric is cost it weights peak usage a lot more heavily than

[4] Other countries have also developed methods, but comparative review of them is beyond the scope of this paper.

off-peak. Use of this method or of source energy eliminates one cause of suboptimization by making the substitution of a fuel with high impact for one with low impact raise the energy use rating, and typical results are similar to those derived using source energy.

For simplification and broader reach, the energy estimates in this paper use a constant electricity fuel mix of 0.69 lbs of CO2 per kWh (0.31 kg of CO2 per kWh) and assume a 3.34:1 source to site energy ratio per DOE recommendations. Sartori & Hestnes 2007 found that operational energy over an assumed fifty year life cycle is markedly larger than embodied energy for materials and maintenance. As such a more detailed study would vary the operational electricity fuel mix. For natural gas usage we assume the Pacific Gas and Electric Company (PG&E) reported average of 0.134 lbs of CO2 per kBTU (0.207 kg of CO2 per kWh) which allows for distribution and use. We used DOE's source to site of 1.047:1 when conversions were needed.

**Site Boundaries**

The California Public Utilities Commission (CPUC) has not yet settled on a definition of the boundaries over which energy use has to net to zero, although it is tending to broader definitions, which would permit ZNE "equivalencies". This would allow a site with poor solar or wind access to use resources from nearby sites to meet ZNE goals, while the most restrictive ZNE definitions limit the renewable energy sources to the building footprint and any other location on the property's site including parking structures. There is still disagreement over the extent that remote sources, such as those producing Renewable Energy Credits, are appropriate for inclusion in the definition of Zero Net Energy. The National Renewable Energy Laboratory (NREL) has proposed a categorization of net-zero energy building definitions based on similar criteria (Pless & Torcellini 2010).

The nuances in definitions are not trivial in that they impact development patterns and need to factor where the distributed generation needed to meet ZNE goals is most beneficial and cost effective to the society in which it is located. That is are hundreds of grid-connected, roof-mounted photovoltaic (PV) panels any better than one larger community-scale PV installation connected to the same utility substation? Is the answer to this universal or regionally dependent?

**Transportation Energy**

Distinct methodologies apply to residential buildings compared to commercial. These are discussed next.

**Personal Transportation Energy (for homes).** Transportation energy from homes is considered to be the amount of energy used by residents of a dwelling to travel. The modes of transport include motorized vehicles, mass transit, cycling and walking. Transportation energy can be measured with good accuracy using the results displayed on abogo.org. This site developed by the Center for Neighborhood Technology (CNT) accesses statistical fits that predict average car ownership and usage based on regressions that correlate these rates to such variables as compactness and transit access. The methodology is similar to that of Holtzclaw 2002, which found that the average car ownership rate—the biggest determinant of energy use—can be predicted for a neighborhood with an $R^2$ of 80-90%. Since this method is available for use today, there is no limitation on consideration of transportation energy in residential projects. Perhaps the statistical work underlying the website could be refined, but the results appear to be consistent with the equations in Holtzclaw 2002. Note that the amount of travel due to commuting from home to work and return accounts for only 15.6 percent of person trips and 27.8 percent of vehicle miles of travel (DOT 2009).

**Business transportation energy (for commercial buildings).** The transportation energy use associated with commercial buildings consists of the energy used for employee commuting, customer visits, and business-to-business travel. These include travel by all modes, including automobiles (both single occupancy vehicles and high occupancy vehicles), mass transit, cycling, and walking. There are methodologies for computing these figures for an individual building. The CNT has developed a beta version of a site[5] which estimates Transportation Energy Intensity (TEI) based on data from the Census Transportation Planning Package (CTPP) 2000 and associated census tract. The building's TEI is predicted for each mode of travel for all the employees and visitors. This requires knowledge of the site address, building occupancy type, building size, number of employees, their median income, annual operating days and number of visitors and the region from which visitors travel. The site includes default values for these parameters, which is probably the most repeatable measure of impacts over the life of a commercial building as its tenants change. Further analysis is needed to confirm or refine these predictions. For this paper's analysis the visitors' contribution was set to zero and employees were evaluated on a per employee per day basis. The buildings tested for TEI in CNT's web-based tool were not all a common size. This allowed comparisons between similar buildings.

## Double-Counting Savings

The methodology used for deriving personal transportation energy involves measuring odometer readings of private cars. Thus to the extent that privately owned cars are used for commuting to a commercial building, or shopping at one, or traveling to anther business during the working day using a personal car that the staff member used for commuting will double-count travel that was already recorded using the residential methodology.

At present it is hard to see how such double-counting can be avoided without painstaking individual calculations. Fortunately, there does not appear to be any serious side effect of tolerating the double count. First, there are not any current or foreseeable policies that would ask for a calculation of travel demand summed over all buildings. Without such a sum, the double-count would not lead to errors. Second, the purpose of using transportation energy in measuring the approach to ZNE is to encourage smarter locations, and overestimating travel slightly will offer stronger encouragement for transportation energy savings. This error is tolerable because as noted above the economic value of these savings is higher than for the other forms of energy use. Third, since most current buildings in North America have low location efficiency, the double-counting problem will decline over time.

## Embodied Energy of Building Materials

To create a building requires energy needed to produce construction materials. Building materials typically use energy to extract natural resources, process, manufacture, transport and install them. Additionally some materials will require recurring energy inputs for maintenance or

[5] http://tei.cnt.org

replacement and most also entail demolition and disposal energy. The cumulative energy inputs are termed Embodied Energy.

Embodied energy is a subset of the data available from a full life cycle assessment (LCA). LCA studies evaluate more environmental impacts than simply energy inputs and estimate toxicity, eutrophication, acidification, ozone depletion, greenhouse gas emissions, particulate emissions, and smog contributions. LCA data including embodied energy vary regionally depending on materials, transportation practices and electricity sources. This makes sharing datasets across countries or even states problematic.

The Athena Sustainable Materials Institute in Canada has created life cycle inventory (LCI) databases of materials for North America per the International Organization for Standardization (ISO) standards 14040 and 14044 for LCA calculation methodology. These are accessible in their Impact Estimator software. The Impact Estimator contains data for individual materials and requires some proficiency to use, but the Athena Institute also has a simplified version of spreadsheets, EcoCalculator, which take the same data and compile them into typical construction assemblies such as concrete slabs, curtainwall or windows, interior walls, roof assemblies and more based on regional construction practices which factor in seismic reinforcements. This spreadsheet approach is better suited for early estimates of construction impacts and will be used for this paper's analysis. The EcoCalculator requires knowledge of surface area or volume of material assemblies used in the building.

When we use this methodology to evaluate prototypical buildings, we find that the embodied energy is significant and important as buildings get more efficient and policies direct operational energy toward net zero. Also unknowns like structural lifetime start to matter a lot. The life of a house can exceed a 100 years, but the energy intensive products in it like drywall or windows do not last as long as this. Quantis 2012 created tables of building materials and expected service life, which was used in Frey 2012. For example they assumed lifetimes of 63 years for gypsum board in commercial and residential buildings, and 42 years for windows in commercial buildings, and 44 years for windows in residential buildings. For the analyses in this paper we assumed a 50 year building service life similar to EHA 2008.

Quantis 2012 determined that replacement rates for its Rehabilitation & Retrofit (RR) cases differed from the New Construction (NC) ones. For a 50-year service life the replacement embodied energies were 1.1 to 2.3 times the original materials' energy and emissions. For this paper's analysis the replacement material energy was conservatively fixed at 1.0 times the initial value for respective NC case in commercial and residential. This would assume that even though the RR case may have half the initial embodied energy of the comparable NC version, they would both have the same replacement materials over the 50 yr study period. More research should be done to validate replacement materials assessment. Additionally Sartori & Hestnes 2007 found that operating energy over 50 years exceeded materials' energy inputs even when low energy buildings increased mass by adding materials in order to reduce operational consumption.

## Embedded Energy in Water

Energy embedded in water refers to the amount of energy that is used to collect, convey, treat, and distribute a unit of water to end users, and the amount of energy that is used to collect and transport used water for treatment prior to safe discharge of the effluent in accordance with regulatory rules (GEI/Navigant 2010).

California agencies and utilities have been studying the water-energy nexus for the past decade with the goal of better understanding the linkages between these two scarce resources. Besides the filtration and treatment, many regions in CA are not gravity fed and require pumping water across vast distances and over mountain ranges to provide fresh water. Then utility water districts treat their waste water in facilities which require more energy inputs prior to disposal (when not in an overflow emergency event).

The California Energy Commission (CEC) and CPUC have funded studies that assessed the embedded energy in water delivery and treatment for various water districts in the state. These range from low energy regions where there is little filtration and the municipal systems are largely gravity fed to high energy input systems that utilize desalinization or large pumping energy. The embedded energy varies from below 1000 kWh per 1 million gallons to twelve times that. The CPUC study (GEI/Navigant 2010), also found large seasonal variations.

In this paper we will use two annual averages for a given site as recommended by Gary Klein of Affiliated International Management. For indoor water use which is presumed to be treated downstream in a waste water treatment plant we will use the full embedded energy from the CPUC studies. For outdoor water use such as irrigation and pool makeup water, we assume that none of the water runs off the site thereby avoiding any downstream water treatment. We are assuming that all water supplied and used is potable. Strategies such as rainwater harvesting could reduce potable water use, but are not commonplace. For statewide California indoor water use we are using 5.0 kWh/1000 gallons (1.3 kWh/1000 L) and for exterior uses we are using 2.5 kWh/1000 gallons (0.66 kWh/1000 L) (Klein 2012).

### Estimating Water Use

Unlike predicting energy use for a proposed building using energy model simulations, there are fewer tools for estimating water use. Projections could be based on statistical data for indoor water use based on occupants and fixture flow rates. This is typically done for Leadership in Energy and Environmental Design (LEED) water efficiency credits but ignores water use for non-EPACT fixtures and appliances such as dishwashers, clothes washers, ice makers, humidifiers, swimming pools and any and all heating, ventilating and air conditioning (HVAC) and process water uses. The former uses are rated under the National Appliance Energy Conservation Act for water use, but the latter uses if present in a building can be more than half of the potable water consumption.

**Indoor.** The daily residential indoor per capita water use ranges from 45-85 gallons (170-332 L) depending on the age of the fixtures and their compliance with current EPAct 1992 or newer water efficiency requirements. This includes the US EPA estimated average American home leaks 10,000 gal per year (38,000 L per yr). Water efficient homes can reduce consumption from the higher end of this range by 50% and eliminate leaks. This yields a range of 45,000-85,000 gal per year (170,000-332,000 L) of indoor use per average California home. For the baseline indoor water use in this paper we will assume 60 gallons per capita per day (gpcd) (227 L per capita per day).

For over a decade LEED indoor water use credits in commercial buildings focus on toilet room and pantry fixtures and those which go beyond the federal levels. As such, estimating building water consumption due to bathroom use is fairly routine in commercial buildings.

**HVAC.** California and much of the Southwest are prime conditions for evaporative cooling—both indirect and direct. The summers are generally not humid, which provides hot dry air to absorb moisture. Evaporating water at room temperatures near seal level requires about 1050 BTU per pound of water (2453 kJ/kg). This heat is taken from the air stream which lowers the air temperature accordingly. The efficacy of evaporative cooling will vary based on the wetting media, the ambient wetbulb and indoor conditions desired. Typical evaporative cooler efficiencies and operating conditions result in 1.4-3.0 gal per hr per ton of cooling or 30 gal per day. In CA this could yield 2000-4000 gal per yr (8,000-15,000 L/yr) for evaporative cooling in homes. Our allowance for evaporative cooling when included is 3500 gal per yr (13,000 L/yr) and will reduce the vapor compression-based cooling by 2000 kWh/yr. This compares to about 18 kWh/yr of embodied energy in the water: a good tradeoff from an energy-centric perspective.

What is less standardized is estimating water use in cooling towers and other HVAC equipment. EPA estimates a typical office building uses 26% of its water usage for heating and cooling, while The Alliance for Water Efficiency estimates cooling towers can account for 15% to 50% of an office building's water use when present. Commercial buildings with cooling towers serving condenser water systems may consume 2.4 gpm per ton-hour (0.043 L/s per kWh). Cooling towers are typically sized for a peak cooling occurrence at a high humidity design day when evaporative cooling is less efficient due to the existing saturated air. Weather does not remain at peak, cooling loads fluctuate and buildings may shut down or may have a reduced operating schedule. All these factors make cooling tower operation and subsequent water use not constant. Makeup water lines to cooling towers are rarely metered separately and typical blowdown cycles are automated rather than done when actually needed. These items lead to high water use without actually being able to directly quantify it. Conductivity controllers permit towers to monitor water quality and have higher cycles of concentration, which reduces blowdown and subsequent makeup water needs. Load profiles can help estimate part load water usage, but cooling tower operators can shift loads off of a chiller for example and onto the tower, such as water side economizers. Better tools are needed for HVAC water usage predictions and simulations.

For this paper cooling tower water use was estimated at 4 cycles of concentration, operating 260 days per yr, with a 300 ton (1055kW) tower sized for a 7°F (3.9°C) approach with 0.002% drift.

Winters in California's population centers are milder than most other portions of the country. As such when saturated cold air is heated to indoor temperatures, in CA the resulting conditions are not as dry as cold climates. This reduces humidifier usage. For the purpose of this paper we are not including any humidifier water use in commercial or residential estimates.

**Outdoor.** The amount of water used for exterior purposes such as irrigation, ornamental fountains, pools, spas, sidewalk washing and vehicle washing is difficult to predict based on site location and lot size alone. Landscaping plans can help determine plantings, their watering needs and the type of irrigation system designed.

**Irrigation.** Document searches for turf grass watering in California and the Southwest reveal that water use varies based on types of grasses planted, seasonal growing and dormant periods, ambient conditions when watering occurs, type of irrigation system and available precipitation. Rules of thumb recommend turf grass is watered one inch of water per week. Based on growing periods for the SW and CA rain patterns we are estimating 20-30 gal/sf/yr (7-10.6 L/m2/yr) of turf grass. This could be refined by further research. Some cities have ordinances such as

Prescott, AZ which allows up to 33.6 gal/sf/yr (11.8 L/m2/yr) for a maximum of 1000 sf (93 m2) of high water use plants. The LEED water efficiency credit for irrigation looks at the peak month in which watering occurs and provides credits based on reductions from this baseline, but unlike their indoor fixture calculation, irrigation is not estimated for annual consumption. For the purposes of this paper we will allocate 25 gal/sf/yr (8.8 L/m2/yr) for turf grass.

**Pools**. Predicting pool water consumption requires a number of variables: surface area, hours and months of operation, splashing/activity, ambient wetbulb, wind velocity, precipitation and pool cover use. Typical residential pool sizes range from 450-550 sf (42-51 m2) in surface area (Lee & Heaney 2008). The CEC estimates that pools can consume the same water per unit area as irrigated lawns, but that pools are not typically used year round; therefore pool water use per annum is typically smaller than lawn usage. For this paper we are assuming 16,000 gal/yr (60,000 L/yr) when pools are present.

**Process and other uses.** For residential and commercial purposes we are not allocating any process water consumption. EPA and Federal Energy Management Program estimate 9% of building water use is miscellaneous along with 15 gallons of water per person per day (gpd) (56Lpd) for all uses. This permits some rough approximation for total water usage and some granularity for end use projections.

## Results

We next use the methodologies discussed above to quantify the energy and emissions impacts of several prototypical examples of residential and commercial developments. We begin by summarizing the results for energy and greenhouse gas emissions in Figures 1 to 4.

These figures illustrate that at least three of the four factors we have discussed are significant contributors to total energy impacts in all cases, and that their relative impacts are different between the different prototypes. These additional parameters matter, in that their magnitude is large compared to direct utility energy impacts and in that they do not vary in proportion to each other, but rather change their relative impacts across prototypes.

### Analyze Multiple Commercial and Residential Properties

Residential studies:

1. Review impact of a typical subdivision with a new home.
2. Review impact of the same home in a transit oriented development.
3. Review impact of a swimming pool.
4. Review impact of lawn size.
5. Review impact of evaporative cooling.
6. Review impact of major renovation rather than new construction.

**Figure 1: Residential Annual Energy Inputs in kBTU**

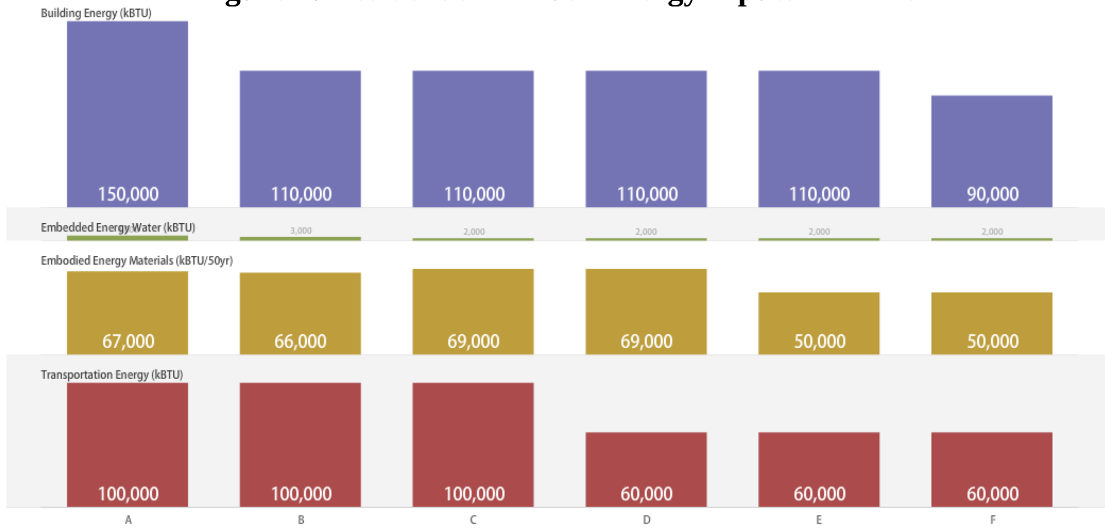
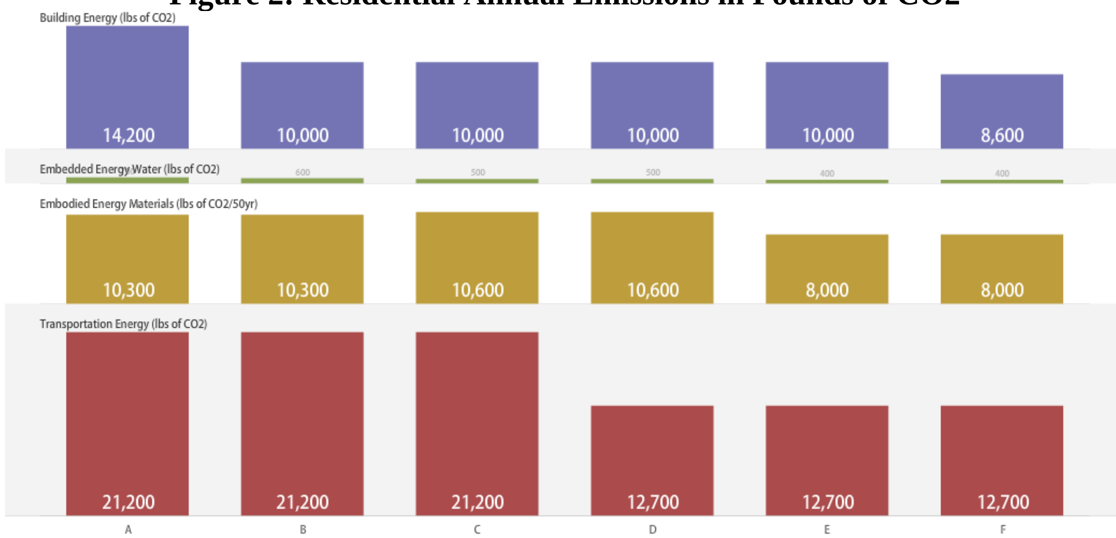



**Figure 2: Residential Annual Emissions in Pounds of CO2**




Residential examples tested:

A. New 2-Story 2700 sf Single Family Home over Crawl Space in Suburban Development with Pool with 0.2 acres of lawn.

B. New 2-Story 2700 sf Single Family Home over Crawl Space in Suburban Development with 0.2 acres of lawn.

C. New 1-Story 2100 sf Slab on Grade Single Family Home in Suburban Development with 0.1 acres of lawn.

D. New 1-Story 2100 sf Slab on Grade Single Family Home in Transit-Oriented Development with 0.1 acres of lawn.

E. Renovated Single Family Home in Transit-Oriented Development with 1/16th acre of lawn.

F. Renovated Single Family Home in Transit-Oriented Development with Evaporative Cooling and 1/16th acre of lawn.

Assumptions:
California has an average 2.85 persons per household.
All of the above were studied in the same climate zone.

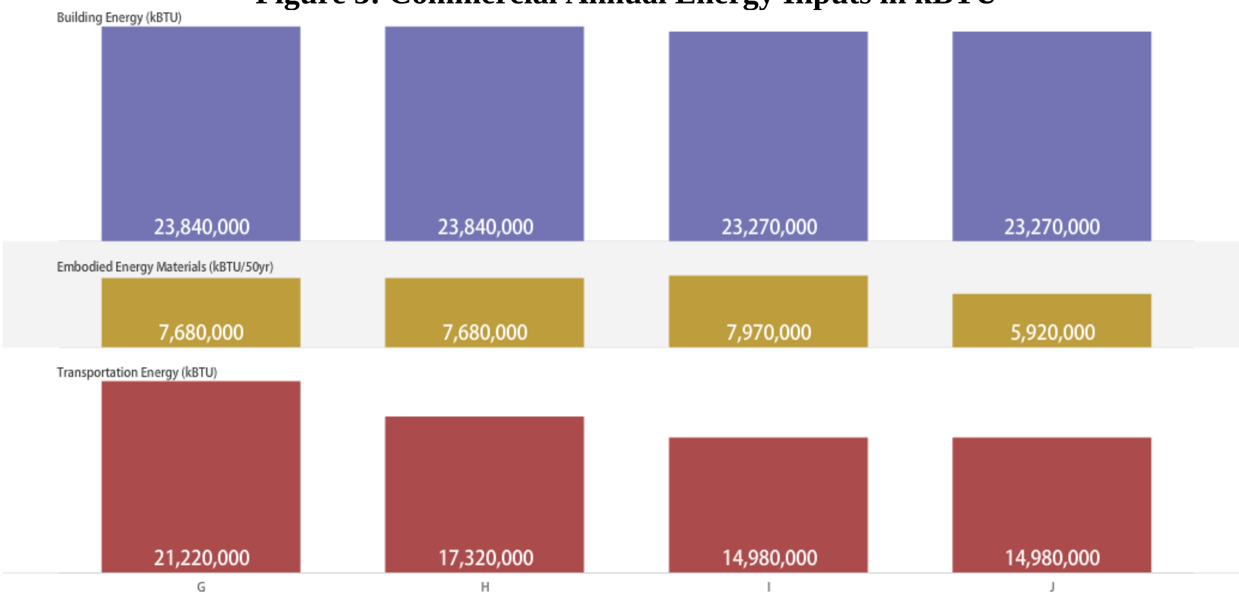
Home models:

CEC has prototype buildings in its energy code[6]. We used Prototype C[7] and D[8] as templates for the above studies. These building plans specify geometry but not the properties which are described in the energy code.

Commercial studies:

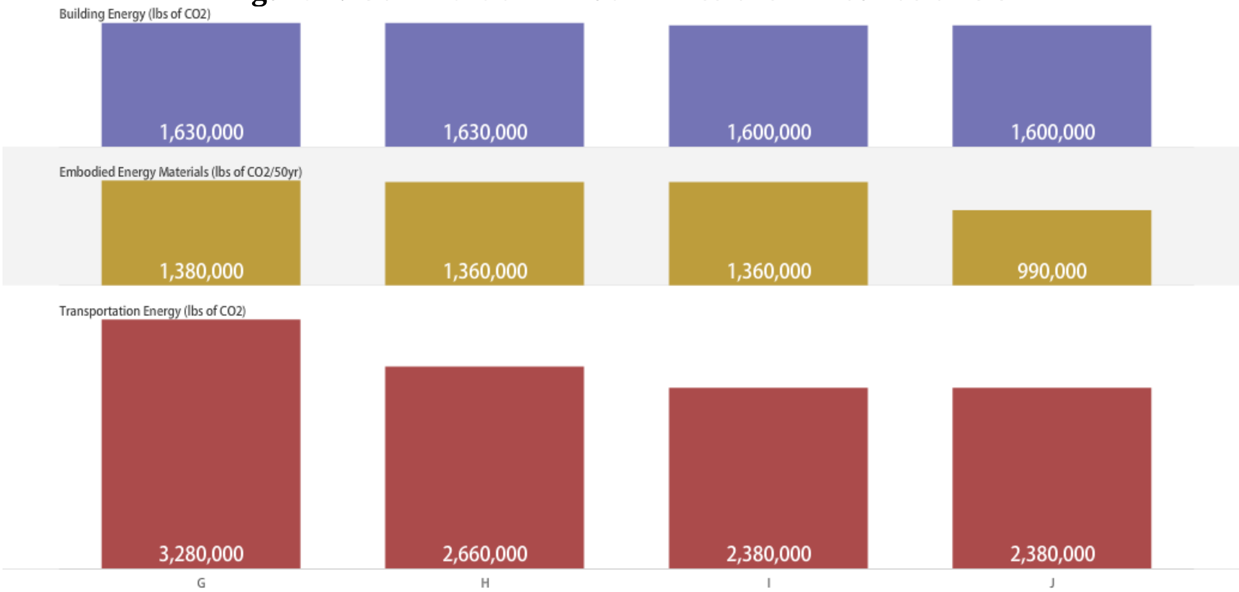
1. A low rise office building in a suburban park with landscaping.
2. Same office building but in a transit-oriented location.
3. New office building with same floor area but high-rise in urban infill site.
4. Same high-rise office building with the same floor area but with reused structure and urban infill site.

**Figure 3: Commercial Annual Energy Inputs in kBTU**




[6] Section 4.2.2.1 of the 2008 Residential Alternative Calculation Method (ACM) Approval Manual
[7] Prototype C is a 2,100 ft², one-story, single-family detached home
[8] Prototype D is a 2,700 ft², two-story detached home

**Figure 4: Commercial Annual Emissions in Pounds of CO2**




Commercial examples tested:

A. A low rise 3-story 150,000 sf office building in a suburban park, with air-cooled rooftop HVAC equipment and multizone VAV distribution. Site contains approximately 1-acre of sprinkler-irrigated turf grass.

B. Same office building but transit-oriented location and with approximately ½-acre of sprinkler-irrigated turf grass.

C. New 6-story office building with same 150,000 sf floor area, with water-cooled HVAC equipment and multizone VAV distribution in urban infill site. Site does not contain irrigated landscaping. HVAC system includes a 300-ton cooling tower with 4 cycles of concentration.

D. Similar high-rise office building with the same floor area and same water-cooled HVAC equipment and multizone VAV distribution in urban infill location but with reused structure and new glazing.

Assumptions:
Each office had 250 gross sf per person and operated 260 days per year.
All of the above were studied in the same climate zone.

Note: the commercial building water usage varied from 800,000 gal/yr to 2.0 M gal/yr, but resulted in embedded energy of only 19-23 MBTU/yr with only 1.5-2.5 tons of $CO_2$/yr.

## Conclusions

We demonstrated that a full quantification of the energy impacts of homes or commercial buildings can be performed to sufficient accuracy to be used with current tools and methods. We estimated the impacts on overall energy use from the four parameters identified as potential suboptimization problems in the policy formulation that will drive buildings towards zero net energy use over the next decade or two, and found that the data validate our hypothesis *that the consequences of suboptimization can be significant*.

Both for transportation and for embodied energy, the inclusion of these new factors changes the total energy use significantly, and such inclusion allows policy makers and building developers to make “greener” decisions than a sole focus on utility energy allows. The analytic process that we used to produce these results is sufficiently robust and repeatable. It can be used to evaluate policy progress toward net zero energy beginning right away, while recognizing that several elements of the methodology could benefit from refinement.

In particular, further analytic development should focus on transportation impacts from commercial buildings. As shown in the case studies, these effects are both large and subject to uncertainty both with respect to data and to methodology. The methodology is also relatively weak for water. But since the water impacts on energy are not so large—in the case of urban[9] office buildings they are negligible--the underdevelopment of water methodology does not prevent its inclusion in this approach today. Further refinement and review of the water-energy nexus is still warranted to fully quantify energy impacts on water use. This paper only reviewed emissions and energy inputs to water, ignoring potential consequences in terms of financial cost.

Embodied energy of initial and replacement materials indicates the energy inputs of the construction materials can be 20-30 yrs of home energy use while the emissions due to the materials can be even higher on the order of 40-50 yrs of operational energy use; this is perhaps due to the fuel mix assumed in the LCI. New construction commercial buildings can have embodied energy equivalent to 10 to 20 yrs of operational energy, this figure is already high because of California’s low carbon fuel mix, which will only increase in the future. This increase is assured not only because buildings will become more efficient, but also but also because the carbon intensity of electricity will decrease in the coming decades to meet the state’s 33% renewable portfolio standard.

Renovation over new construction can greatly decrease the embodied energy while potentially approaching the energy efficiency of a new construction home or office building. The assumed building life greatly influences the benefits of one over the other, but clearly other characteristics such as location are as important.

The current calculations do not consider demolition energy. Methodologies that can address demolition must encompass policy as well as analytic issues. For example, does the energy needed to demolish a derelict building get counted when a new building is constructed on the same site? What if the choice is to build a new building in place of the old one versus choosing an entirely new site? What if the site is to be rezoned to a higher density than the previous structure could accommodate?

Transportation energy is almost equal to the operational energy of a low energy commercial building. The significance of transportation is that developers often have the opportunity to make choices that increase density or focus development around transit availability, and the choice of density may represent a tradeoff with the availability of solar on-site. It is also significant in the context of new urban development plans in California that are developed in accordance with the Sustainable Communities and Climate Protection Act of 2008 (“SB375”).

These new plans, which often include large expansions of transit access, empower developers to make choices of building at higher density in neighborhoods with greater connectivity, and will encourage infill and, potentially, upgrading and reusing existing buildings

[9] An urban office building will not use significant water for landscaping.

rather than demolition in one place and construction somewhere else. These factors—density at the Traffic Analysis Zone level (such a zone is intermediate in area between a ZIP code and a Census Tract), transit service levels, and to a lesser extent pedestrian/cyclist accessibility and proximity to services, are the primary determinants of transportation energy use (Holtzclaw 2002). Knowing quantitatively the tradeoff between utility energy and transportation energy will allow better decisions to be made.

California has a low carbon electricity mix with policies enacted to reduce this even further in the coming decade. California also has some of the most stringent building energy codes of any state, which will keep operational energy use and subsequent emissions low. While the transportation energy use, as noted, is similar to operational energy in magnitude, its emissions are much greater owing to the fact that automotive transportation dominates and at present are largely fossil fuel-driven. Aggressive low carbon fuel standards, new federal Corporate Average Fuel Economy Standards, and adoption of electric vehicles could bring transportation emissions per unit of energy use to parity with building operational energy-related emissions. A more detailed study could estimate long term emissions impacts. Any policies interested in reducing greenhouse gas emissions should include building location.

We note therefore the importance of further development of models that predict travel demands of commercial buildings. In performing the analysis presented in this paper, we looked at the travel demands of a downtown office building located near one or more mass transit systems with those of an office in suburban environments, and in one particular case found lower impacts in the suburb. This was a consequence of the employees of that particular neighborhood all living nearby. The authors feel that this result is anomalous, in that it does not predict the consequences of additional offices being built there. Further research is necessary to see if this feeling is justified and if more refined methods are necessary.

Finally, we note that by expanding the scope of energy that should be considered in the context of a zero-net goal, we have changed the context of the goal. Thus, if we were to define a scale in which 100 is the system-wide impact of today's energy use, and "net zero' is recalibrated to zero out system-wide energy use, the score of a building with net zero utility energy would be about 40 to 50. This raises the question of what a reasonable policy goal for system-wide energy impact should be. Is 40 or 50 still the right goal? If not, should the goal be lower or higher, and what arguments support such a modification?

Further analysis beginning with the methods discussed in this paper could shed light on what a reasonable system-wide energy goal should be.

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# Attachment C

April 3, 2013

Commissioner Andrew McAllister
California Energy Commission
1516 Ninth Street, MS-31
Sacramento, CA 95814

**Re: NCPA and NRDC Joint Statement Regarding Evaluation of Energy Efficiency Programs and Assembly Bill 2227**

Dear Commissioner McAllister:

The Northern California Power Agency[1] (NCPA) and the Natural Resources Defense Council (NRDC) would like to share with you our joint position regarding the impacts of the recently enacted Assembly Bill (AB) 2227 on energy efficiency evaluation.

As you are likely aware, public power utilities across the state have long recognized the importance of evaluating the effectiveness of utility energy efficiency programs. Publicly owned utilities (POUs) view the requirements of Public Utilities (PU) Code section 9505, as amended in AB 2227, as maintaining the original annual reporting requirements contained in AB 2021 (Levine, 2006).

Since the passage of AB 2021 in 2006, each publicly owned utility has been required to report, on an annual basis, the results of an independent evaluation that measures and verifies it energy and demand savings ("EM&V analysis"). Specifically, AB 2021 required that "Each local publicly owned electric utility shall report annually to its customers and to the State Energy Resources Conservation and Development Commission . . . the results of an independent evaluation that measures and verifies the energy efficiency savings and reduction in energy demand achieved by its energy efficiency and demand reduction programs."[2] The POUs include their EM&V analyses in their annual reports to the Commission, due on March 15 of each year.

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[1] NCPA members include the cities of Alameda, Biggs, Gridley, Healdsburg, Lodi, Lompoc, Palo Alto, Redding, Roseville, Santa Clara, and Ukiah, as well as the Bay Area Rapid Transit District, Port of Oakland, and the Truckee Donner Public Utility District. NCPA's Associate Member is the Plumas-Sierra Rural Electric Cooperative.

[2] AB 2021, Ch. 734, Section 3(e)(3). (Formerly PU Code § 9615(3)(e)(3).

NCPA and NRDC believe that nothing in AB 2227 and the amendments to PU Code Section 9505 are intended to change the original requirements of AB 2021 with regard to these EM&V analyses and reports. Specifically, language in the statute memorializes POU commitments to continue annual reporting to the Commission on the total investments in energy efficiency, descriptions of the program expenditures, cost-effectiveness of the programs and expected savings, the sources of funding, and methodologies and inputs used to determine cost effectiveness (§ 9505(a)). Because the intent of AB 2227 was not to change anything substantive from the previous version of the PU Code, annual submittals of the results of independent EM&V analyses are still required, consistent with the provision of AB 2021 quoted above.

As an added point of commitment, it is also the intention of NCPA to inform Commission staff whenever an EM&V report is complete, independent of the due date for the energy efficiency report.

Both NCPA and NRDC look forward to the development of guidelines for independent evaluations of energy efficiency and demand reduction programs. We urge the Commission to reflect public power's commitment to meeting the original EM&V requirements in AB 2021 in its guideline publication. We also look forward to continuing to work with the Commission to pursue all cost-effective energy efficiency.

Sincerely,

JAMES H. POPE
General Manager
Northern California Power Agency

RALPH CAVANAGH
Co-Director, Energy Program
Natural Resources Defense Council

cc: Chairman Robert Weisenmiller, California Energy Commission
Commissioner Karen Douglas, California Energy Commission
Commissioner David Hochschild, California Energy Commission
Commissioner Janea Scott, California Energy Commission
Robert Oglesby, Executive Director, California Energy Commission
Office of Governmental Affairs, California Energy Commission
Patrick Saxton, Advisor to Commissioner McAllister, California Energy Commission