Sierra Club Comments on Desert Renewable Energy Conservation Plan EIR/EIS

Regarding Acreage Calculation and Determination of Need
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Sierra Club appreciates the opportunity to comment on the draft DRECP, and focuses in these comments on the area where we see a significant need for improvement. Primarily Sierra Club would like DRECP to use the most up to date demand forecast, account for publicy owned utility efficiency savings, use correct values for existing zero carbon resources, adopt supportable amounts of energy storage and distributed generation, and use actual data for existing renewable projects in the DRECP for estimates of acreage and balance of resources needed to meet the megawatts target. Once correct values are assumed, the result is a significant reduction of need to between 10,000 and 15,000 megawatts in the DRECP occupying about 175,000 to 200,000 acres. Consistent values should be used throughout the document, and a spreadsheet model should be circulated as support with the correct and up to date values entered. Also, the Alternatives in appendix F2 should be rebalanced to account for projects already under construction or built, since some alternatives have less wind than has already been built, so this analysis needs to be corrected to make the alternatives feasible and valid.

A. The Context of the DRECP Acreage Model

Key Points:

- Contrary to DRECP claims, the resource mix is not consistent with current state policies
- DRECP assumes future reduction in deployment of energy efficiency and distributed generation
- DRECP assumptions are biased toward increased utility-scale generation

1. Assumptions in the DRECP are Inconsistent with Current State Policy.

The primary basis of the Desert Renewable Energy Conservation Plan (DRECP) is the assumption that there is *a need* for development of renewable energy resources located in the desert region that the plan covers. A spreadsheet calculator was developed that input various data in order to quantify the renewable power needed to meet a statewide policy goal for reducing carbon dioxide (CO_2), and then estimate the land area that might be required for this purpose. A portion of this projected amount of renewable energy was then assigned to the DRECP. While there are many assumptions in the spreadsheet model, there are four principal elements that determine whether there is a need for renewable energy in the DRECP region, and if so, the amount of that need, including:

- A projection of electricity demand at a defined future target date

- An assumed goal for reducing carbon dioxide emissions in the electricity sector
- A proposed mix of energy resources and
- A share of renewable energy that is assigned to the DRECP region, and the land area this would require.

The overarching context for the determination of need in the spreadsheet model is California's target to reduce carbon dioxide emissions 80 percent by 2050, a goal established by Governor Schwarzenegger in Executive Order S-3-05.[1] The Sierra Club strongly supports this goal. In 2015, state Senator Pavley introduced new legislation (SB 32) that would codify this target into law and authorize the power to establish interim targets. In the earlier drafts of the DRECP spreadsheet, a few scenarios were developed that projected need for renewable energy out to the 2050 target of 80 percent CO2 reduction. However, the plan subsequently dropped references to 2050, due to many compounding uncertainties when making projections that far into the future—about energy demand, technologies, and policies.

An interim target of 58 percent reduction of CO2 emissions was interpolated for 2040 and assigned to the electricity sector, and this became the primary policy objective that the plan was intended to help meet. Existing state policy *does not* assign a specific carbon emission reduction target for 2040, nor does state policy assign a specific cap to the electricity sector. Rather, the cap applies to all emitting sectors combined, covering electricity as well as transportation fuels and industry.

The following policy framework was followed to establish a need for renewable energy in the DRECP:

- Adopt a 58 percent carbon dioxide reduction in the electricity sector for 2040;
- Add 17,000,000 electric vehicles to electricity demand by 2040 on the path to full electrification by 2050, greatly increasing the "need" for DRECP resources compared to only addressing the electricity sector;
- Account for alternative compliance mechanisms for meeting the carbon goal; initially assuming offsets could be used which would have reduced the need for renewable energy; then later removing this provision—which increased "need" for DRECP resources;
- New data reduces the carbon baseline of the electricity sector in 1990 from 115 million tons to 110 million tons; this also (paradoxically) increases the "need" for DRECP resources.

In addition to reducing CO2 by 58 percent in the electricity sector, from the very beginning the DRECP assigned to itself the assumed task of cleaning up the transportation sector. This is not strictly speaking within the scope of the DRECP, although it is an interesting exercise in possible futures. There are various problems with addressing other sectors such as transportation. Perhaps the biggest problem is that the DRECP did not formulate a credible plan for transportation, but simply made assumptions, some of which were not consistent with current state policies. Two examples of this inconsistency are the refusal to include in DRECP any assumed reduction in

[1] http://gov.ca.gov/news.php?id=1861

vehicle miles traveled, or any assumed improvement in vehicle efficiency, even though these are explicit measures in the state's Climate Plan.

This attempt to swallow two sectors—electricity and transportation—into the DRECP also creates a serious counting problem, particularly since DRECP was assuming a separate CO2 reduction target in the electricity sector, which therefore should have been distinct from a CO2 reduction goal for transportation. Of course, adding the burden of transportation makes it much more difficult for the electricity sector to get to a specific carbon reduction goal, especially when the resulting reduction in CO2 is not counted in that other sector.

The actual current policy approach under California's Climate Scoping Plan (the "Climate Plan") for the electricity sector is to set targets defined in dual terms: 1) amounts of electrical energy, and 2) projected equivalent amounts of CO2 reduction. However, when these measures were defined through legislation, they were only quantified in terms of electricity rather than greenhouse gases. This has specific ramifications for how the policies are implemented.

For example, the DRECP calculator had an input assumption that previously allowed 8 percent carbon offsets for compliance purposes toward the carbon reduction goal. However, in the current draft DRECP plan, it was decided to remove the offsets—which increased the amount of renewable energy that is needed to meet the 58 percent greenhouse gas reduction. The assumption of offsets was removed based upon an understanding that offsets do not reduce the cap. This interpretation is *inconsistent* with current policy for two reasons. First, there is no cap specifically for the electricity sector in current policy, so it is certainly possible for *offsets* to be applied as a greenhouse gas measure. The DRECP never considered the other carbon compliance mechanism where electricity suppliers can buy and sell *allowances* under the cap and trade system. This carbon cap for electricity, and the removal of offsets for the electricity sector, appears to have been an invention of DRECP to justify the renewable energy target—ignoring inconsistencies with current policy for how the renewable portfolio standard and other clean energy policies in the electricity sector are established or measured.

Because the DRECP model did not properly consider carbon offsets, the actual alternative compliance mechanisms were not considered. The law that requires increasing renewable electricity to 33 percent does indeed have alternative compliance, such as allowing purchases of unbundled renewable energy certificates (RECs) that are not tied to the actual delivery of electricity. Up to 10 percent of new renewable energy purchases are allowed to be in the form of RECs, but this is nowhere reflected in the DRECP model. The law also has multi-year compliance periods, which allows the utilities significant flexibility to adjust to changes in electricity supply and demand, or delays in renewable energy projects coming on-line.

Sierra Club did not object in the past to this sector-specific greenhouse gas cap, partly because there was no previous claim that DRECP was consistent with current policy. The current draft DRECP does make this claim. Additionally, in the current draft DRECP, the removal of the 8 percent offsets was newly introduced *in the specific context of removing part of the benefits of rooftop solar energy* from meeting the statewide carbon goal assumed by the DRECP. This is brought up in the section aptly titled **"Revision to July 2012 Scenario Based on Correction of**

Assumed 1990 GHG emission Baseline and Revised Modeled Impact of GHG Offsets, Including Customer-Side DG Solar." [2]

Therefore this change in carbon accounting requires a new examination of the implications of how state policies are applied to the DRECP spreadsheet model. If the previously assumed 8 percent purchase of carbon offsets is removed, then the other appropriate alternative compliance—the currently legal purchase of RECs *up to 10 percent of total new renewable energy purchases*—should be put in its place. For a requirement of 66 percent renewable electricity, this would mean up to 6.6 percent purchase of RECs, particularly since by 2040 nearly all contracts would be *new since the 33 percent RPS law took effect*. Again, in this context, the DRECP should not be allowed to pick and choose which policies it wants to comply with, especially when it is claiming to be consistent with state policy.

Four specific measures are assigned to the electricity sector in the Climate Plan:[3]

California Climate Plan Electricity Sector Policy Targets for 2020

Climate Plan Measure	Incremental Electricity %	Incremental Energy in GWh/year	Million Metric Tons CO2 Reduction
Renewables Portfolio Standard (Increased from 20% to 33% of Retail Sales)[4]	11%	33,000	21.3
Energy Efficiency	11%	32,000	15.2
Combined Heat and Power (4000 MW)	10%	30,000	6.7
Million Solar Roofs (3,000 MW)	~2%	5,000	2.1
Total	~34%	~100,000	45.3

One of the features of the Climate Plan is the remarkable balance between different policy targets, as measured in electrical energy. Prior to the Climate Plan, the state had already adopted a requirement that 20 percent of electricity would come from renewable energy sources by 2010. The Climate Plan proposed increasing this to 33 percent by 2020. The additional energy beyond the previous goal of 20 percent renewable energy another 33,000 gigawatt-hours to reach 33 percent; energy efficiency is another 32,000 gigawatt-hours, and customer-sited electricity generation (solar energy and combined heat and power) is another 35,000 gigawatt-hours. Interestingly, new additions for customer-sited generation are slightly larger than each of the other items, and the implied pace is an increase of about 1 percent per year for each of these three categories (utility renewable energy, customer efficiency, and customer generation) over the course of about a decade.[5]

[2] DRAFT Desert Renewable Energy Conservation Plan (DRECP) and Environmental Impact Report/Environmental Impact Statement, Prepared by: California Energy Commission, California Department of Fish and Wildlife, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, SEPTEMBER 2014. (hereinafter called "Draft DRECP"), Appendix F3, p.20.

[3] Climate Change Scoping Plan, California Air Resources Board, December 2008, targets shown in tables on pages 44, 46 and 53.

[4] While the difference between 20% and 33% is nominally 13%, California's renewables portfolio standard is defined based upon percentage of retail sales rather than electricity generation. Because this omits line losses of about 7.5% of electricity generated, the difference is smaller than 13% of electricity generation.

[5] The 33% RPS was intended to be implemented between 2010 and 2020, but because meeting the 20% RPS was delayed by a couple years, the additional renewable energy to get to 33% would have to be procured even more quickly than 1% per year. Implementation of the combined heat and power targets was also delayed. The Million Solar Roofs is a ten year program, but it runs on a different time cycle—between 2007 and 2016.

For clarification: the Energy Commission uses the term "self-generation" to refer to both rooftop solar and combined heat and power, which covers electricity generated for the customers' own use. However, combined heat and power systems are assumed in the DRECP model to export about half of the electricity they produce to the grid, and therefore this exported energy becomes part of the electricity supplies of utilities. In other words, these "self-generators" are actually producing significantly more total energy than is accounted for by only looking at self-generation; and these facilities provide many benefits to the grid including local reliability and greater efficiency of energy use. In order to capture the full energy produced by these sources, Sierra Club uses the term "customer-sited generation," which includes the electrical energy produced by these generators for both self-consumption and grid benefit combined. Combined heat and power systems also produce heat, but this is not considered here, and is treated as external to the electricity sector in the DRECP model.

The balance of resources in the Climate Plan contrasts rather starkly with the DRECP spreadsheet analysis, which assumes no more combined heat and power electricity generation in 2040 from what the Climate Plan target assigned for 2020.[6] The DRECP model assumes the addition of only 7,000 megawatts of "rooftop solar" between 2017 and 2040, which does not come close to making up for the assumed stagnation of combined heat and power. Thus, new customer-sited generation in the DRECP model is assumed to carry a much smaller portion of the burden for meeting state climate protection targets than in the state Climate Plan.

Similarly, additional energy efficiency beyond what is embedded in the demand forecast has been assumed by the DRECP model to save electricity at a much slower rate than existing state policy of 10 percent per decade, a goal that is—like the renewables portfolio standard—enshrined within the Climate Plan and enforced through state legislation.[7]

Below is a summary table of the incremental new measures for reaching the state's climate goals assumed in the DRECP model. The baseline from which these measures are "incremental" is not entirely consistent. For example, new renewable energy and combined heat and power are measured from what is built after 2010, while energy efficiency is estimated beginning from 2012 according to what is additional to the efficiency already embodied in the official Energy Commission demand forecast's baseline "unmanaged" growth. This method is similar to how the energy efficiency goal in the Climate Plan is defined, and how Additional Achievable Energy Efficiency is calculated in the official Energy Commission demand forecast. Rooftop solar self-generation is incremental to the Million Solar Roofs program, which is expected to build 3,000

[6] The Climate Plan calls for slightly less capacity (4000 megawatts versus 4500 megawatts in DRECP of combined heat and power.

[7] State Assembly Bill 2021 (Levine, 2006) called for a 10% reduction in California's electricity demand in ten years. http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA62R&re=0&ee=0

http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_2001-2050/ab_2021_bill_20060929_chaptered.html megawatts of net-metered rooftop solar photovoltaics (PV) by 2017, of which 2347 megawatts have been installed to date. [8]

Estimation of Incremental Measures in DRECP Model Assumptions

Plan Elements	Incremental Electricity %	Annual Rate	GWh
New Utility Scale Renewable Energy	48.6%	1.7%	180,000
Energy Efficiency	15.7%	0.6%	58,000
New Combined Heat & Power (4500 MW)	8.6%	0.3%	32,000
New Customer Solar PV (7000 MW)	3.2%	0.12%	12,000
Total	76.2%	2.7%	282,000

As shown in the table above, the DRECP model, unlike the Climate Plan, focuses on utility-scale renewables as the major means to address California's climate goals. For example, additional energy efficiency—rather than being about equal to utility scale renewable energy as in the Climate Plan—only contributes one third as much as utility scale renewable energy in the DRECP model. New customer-sited generation contributes even *less* than energy efficiency. Compared with the relative balance in the state's climate plan, the DRECP model clearly implies a major *decreasing* role for customer-sited energy resources. This assumption is inconsistent, not only with the structure of the Climate Plan, but also with a fleet of other policies in California that are designed to support customer energy conservation and self-generation, including: retail rate design, removal of the cap on net metering, net metering bill credits, surplus net metering cash compensation, customer rebates, utility profit incentives for meeting efficiency targets, decoupling of utility profits from volume of retail electricity sales, state building codes and appliance standards, the combined heat and power feed-in tariff, the Loading Order, and Zero Net Energy buildings. More recently, the Governor's own announcement setting an ambitious climate target highlighted customer-sited generation as a main feature of the plan.

These policies have all been established and moved forward within the context of increasing utility rates and decreasing cost and improving performance of customer efficiency and solar power technologies. Given this framework of state policies, such a major slowdown of important

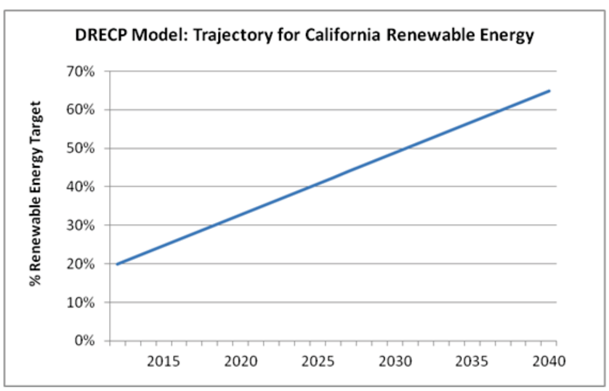
[8] Data from California Solar Statistics, February 18, 2015 http://californiasolarstatistics.ca.gov/; note that this data includes about 250 megawatts that was installed prior to the Million Solar Roofs program through the Energy Commission's Emerging Renewables Program (ERP), the CPUC's Self-Generation Incentive Program (SGIP), and programs of the state's publicly owned utilities. Additional funding expanded the California Solar Initiative (CSI), Single Family Affordable Housing (SASH), and Multi-Family Affordable Housing (MASH) programs beyond the original Million Solar Roofs program, and many net metered projects are now being installed without any rebates. It is not clear if all of these installations are currently being tracked by the statistic provided.

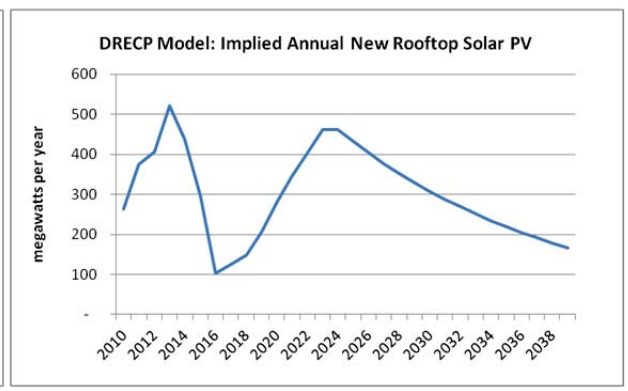
climate and energy policy measures as reflected in the DRECP's assumptions is not consistent with the real context and overall policy goals that are supposed to be at the basis of the DRECP.

The weak assumptions in the DRECP model regarding energy efficiency and customer sited generation stand in stark contrast to statements within the DRECP plan document. The DRECP claims that:

- "the scenarios developed using it [the calculator] *reflect* and *respond* to existing policy set by the state and federal governments by generating helpful predictions"[9] and
- "the July 2012 scenario is consistent with current state policy…." [10]

These scenarios could only be considered "consistent" with state policies for efficiency and self-generation within an artificially narrowed timeframe, by assuming the policy priorities will shift greatly after this decade. For energy efficiency, that would mean only meeting goals for energy efficiency within the period up to 2020 for which the original Climate Plan applied, and meeting the various parts of the Million Solar Roofs program which are to be completed by 2017. After the first decade, the scenarios apparently assume that the pace of implementing these policies will no longer apply. Strikingly, the DRECP-assumed time limitation placed on the current pace of customer energy efficiency and customer-sited power generation is not matched by a similar slowing pace of deployment for utility scale renewable energy. Indeed, the DRECP assumes a renewable energy requirement of 66 percent by 2040, which is *double* the existing policy target and extends 20 years beyond the current target date. DRECP seems to be picking and choosing which policies will have priority, and this priority is not consistent with California's Loading Order, which wisely places energy conservation and efficiency first—before renewable energy.





These charts (above) illustrate the DRECP's highly lopsided approach that loads the vast majority of the burden for meeting climate goals onto utility supplied renewable energy, and leaves customer side resources—such as rooftop solar PV— in outright decline to levels well below current policies and trends. The chart on the right uses Energy Commission forecast data for annual capacity additions of rooftop solar PV up to 2025, and then extrapolates a declining trend line that would match the DRECP assumption of a cumulative 10,000 megawatts of installed rooftop solar PV by 2040. The charts attempt to construct simple progress models based

[9] Draft DRECP, Appendix F3, p.2
[10] Draft DRECP, Appendix F3, p.8.

upon DRECP assumptions of the beginning and target year (2040) values; however, DRECP did not create any time series development model for these two trends—renewable energy and rooftop solar PV—which would have quickly revealed the flawed assumptions.

2. DRECP assumptions that increase need for desert renewable energy are *aggressive*, while factors that would reduce the need are *regressive*.

The DRECP's assumptions are inconsistent and disfavor demand-reducing technologies or policies. The DRECP refers to its approach to scenario design and assumptions as "conservative," or "reasonable if not conservative"[11] multiple times throughout the document. However, these assumptions *are not consistently* "conservative." As discussed previously, the DRECP's assumptions regarding the trajectory of efficiency and customer-sited generation are weaker than reflected in the state's own Climate Plan and associated policies; and from Sierra Club's viewpoint some of the assumptions are not founded on sound reasons.

On the one hand, the DRECP's assumptions on the primary driving factors that tend to dramatically *increase* demand for renewable energy generally, and by implication in the desert, are actually quite *aggressive*. These include: 1) reducing carbon dioxide emissions in the electricity sector 58 percent by 2040 to put it on a trajectory to reach 80 percent reduction by 2050; 2) loading the transportation sector onto the electricity grid through massive electrification of 18 million vehicles by 2040 with the goal of complete electrification of passenger vehicles by 2050; 3) retirement of all nuclear power (in and out of state that serves California's load) before 2040; and 4) overbuilding energy storage, which requires additional generation to make up for the energy losses caused by storing the energy and sending it back to the grid.

On the other hand, the factors that would potentially limit or reduce the amount of renewable energy needed from the DRECP, particularly energy efficiency and distributed renewable energy, are so limited that they do not even rise to the level of conservative; rather they fall far short of what should be expected given state policies and market trends, and may even be called "regressive."

Another allegedly "conservative" assumption embedded in the DRECP energy need analysis is that technology will stay roughly the same in performance and character as today over the next 25 years. Solar panels, wind turbines, and electric vehicles are not assumed to become more efficient; new types of technologies for renewable energy and energy conservation will not be developed. The presentation of the DRECP model states:

- "the calculator attempts to predict central-station renewable and other zero- and low-carbon generation needs could be… and then translates those possible needs into potential implications of that need for development in the DRECP area, *given the current state of technology*."
- "MW assumed of each renewable technology, *as determined by the state of the technology*,…"

[11] Draft DRECP, Appendix F3, p.2, p.3, p.9, and p.24.

However, this approach is in flat contradiction to centuries of steady technical progress, and contrary to even the most sober projections of those who are involved with technology innovation. This assumption of no technology progress is also inconsistent with the publicly cited justification for state policy support of clean energy, that billions of dollars in green venture capital is invested in California.

Thus, with the DRECP's assumptions, some of the most important determining factors that *increase* the need for desert renewable energy are aggressive, while the principal factors that would tend to *reduce* the need are regressive; neither of these in Sierra Club's view reasonably qualifies as "conservative."

To be clear, Sierra Club strongly supports California's policy goals, and believes that aggressive action in all sectors is fully justified. However, it does not make logical sense in a political, technological, and policy environment focused on rapidly and aggressively reducing greenhouse gas emissions through all means, to assume that utility-scale renewable energy will rapidly expand, while energy efficiency and distributed renewable generation will greatly slow down. Yet these are baseline assumptions in the determination of need for renewable energy development in the DRECP.

It is important that the plan reasonably reflect the full range of state policies that support environmentally sound development of energy resources. This includes increase of utility-scale electricity generation. But the plan should also include adequate accounting for the energy efficiency programs of publicly owned utilities, moving forward on Zero Net Energy buildings, Governor Brown's new proposal to reduce building energy consumption in half, for which legislation is pending;[12] and continued development of distributed renewable generation.

3. Electric Vehicle Assumptions are Misaligned with State Policies.

Assuming conversion of all automobiles to electricity without considering other measures that will be necessary to reduce petroleum consumption is directly misaligned with state priorities. While a sizable amount of electricity will very likely be needed for this purpose, which the DRECP model assumes, a reasonable transportation plan in a greenhouse gas-constrained world would also include efforts to reduce driving in single occupancy vehicles, such as policies that support multi-modal transportation and transit-oriented development. These policies are each emphasized in Senate Bill 375, which requires Metropolitan Planning Organizations to prepare Sustainable Community Strategies as part of their Regional Transportation Plans; yet these state and regional priorities and policies were not incorporated into the DRECP model. Sierra Club's recommendation in the 2012 comments that the DRECP model assume even modestly fewer vehicle miles traveled by 2040 was rejected.

While staff provided an explanation that they were skeptical about the effectiveness of state and local efforts to reduce driving, the lack of reduced miles traveled per vehicle in the DRECP model is *inconsistent* with state policy. Indeed, the Climate Plan includes action item number 6,

[12] SB 350 has been recently proposed by Sen. De Leon to reduce petroleum use by half, reduce building energy in half, and increase renewable energy to 50 percent.

Regional Transportation-Related Greenhouse Gas Targets, that is specifically intended to reduce vehicle miles traveled, and the Air Resources Board provided a preliminary quantification of about 4 percent reduction (subject to future revision) based upon a 2008 UC Berkeley study.[13, 14] Furthermore, the Climate Plan cites SB 375 as a statutory basis for implementing measures to reduce vehicle miles traveled through ARB working with the Metropolitan Planning Organizations.

Similarly, the DRECP model did not assume improved efficiency of electric vehicles, even though improving vehicle efficiency is included in the Climate Plan as major action item number Seven. Improving efficiency of automobiles through greater miles per gallon for vehicle fleets is also current federal policy.

While a world where electric vehicles do not improve over time, and where people continue to drive the same amount as today, may be theoretically possible, it is inconsistent with the progression of technology, and *it is especially inconsistent with the state policy goals that are the entire basis for the DRECP plan*. This is yet another assumption that tends to inflate the demand for electricity in the DRECP model, and, in turn, the claimed need for electricity generation in the desert region.

It would have been far more reasonable, in Sierra Club's view, to use a comprehensive strategy for reductions in CO2 in the transportation sector, rather than focusing on one strategy alone—vehicle electrification—to carry the full burden of reducing carbon emissions for passenger vehicles. Key policy guidance was already available for the transportation sector in the State Alternative Fuels Plan, which was prepared by the California Air Resources Board with the Energy Commission pursuant to AB 1007 (Pavley, 2005).[15] The Plan included a 2050 Vision Statement that considered multiple strategies to "help the transportation sector achieve the state's GHG overall emission goal of 80 percent reduction by 2050":

> "To address these questions, the Energy Commission and ARB staff have extended the time horizon from the required 15 years in AB 1007 through 2050. This effort includes a "2050 Vision" that combines three broad strategies as follows:
>
> • Maximize the energy efficiency of vehicle/fuels systems used by Californians.
>
> • Reduce growth in travel demand through transportation efficiency, technology changes in the delivery of goods and services, expanded transit, and more efficient land use patterns.

[13] Climate Scoping Plan, pp.47-51.

[14] Rodier, Caroline. U.C. Berkeley, Transportation Sustainability Research Center, "A Review of the International Modeling Literature: Transit, Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Traveled and Greenhouse Gas Emissions," August 2008. http://www.arb.ca.gov/planning/tsaq/docs/rodier_8-1-08_trb_paper.pdf (accessed October 12, 2008)

[15] http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_1001-1050/ab_1007_bill_20050929_chaptered.html

• Deploy an increasing mix of low GHG emission alternative and conventional fuels to satisfy the remaining transportation energy demand."[16]

Therefore, the DRECP assumptions of no reduction in vehicle miles traveled and no improvement in vehicle efficiency is not consistent with the state's Alternative Fuels Plan, which the Energy Commission helped author.

4. The DRECP's Technical Modeling Data is not Transparent.

The DRECP's energy calculator is not transparent, nor is information provided in a form which the public-at-large could understand and comment on. The draft plan states that "it is not necessarily important for all stakeholders to thoroughly understand the technical modeling history," and that "the following is not intended to be a comprehensive technical listing of all variables and assumptions." [17] However, this failure to present a comprehensive list of all variables and assumptions is not at all consistent with transparency, and seriously undermines the claim that transparency is one of the main purposes of the presentation on the calculator, as well as violating NEPA's obligations to provide information on environmental impacts in a way that is clear and easy to understand. It also conflicts with the importance in NEPA of clearly explaining the basis of the Purpose and Need and in CEQA of clearly explaining the Project Objective. While a lot of important information and data points are presented in the plan document, the inputs and results that are omitted remove much of the context. For example, during the earlier work, copies of the calculator spreadsheets were distributed. However, Sierra Club has seen no version distributed to public participants by DRECP staff that includes all the most up to date and correct inputs that are consistent with the plan document. Thus, many of the assumptions are opaque and must be inferred. This impairs independent analysis and the public's ability to make valid comments.

5. The Calculator's roles are quite different than described in the DRECP.

There is also inconsistency between 1) the way in which the calculator's role in the DRECP is described and 2) the way the calculator is actually used. The entire Appendix F3 is peppered with disclaimers about how the calculator plays no role in determining what actually happens in the DRECP area. For example: "the use of these scenarios to estimate potential development in the DRECP area in the long-run will have no bearing on actual development, which will depend upon the factors enumerated above."[18] However, this is inconsistent with the fact that the calculator is the only rational basis provided in the plan for establishing and estimating the need for desert renewable energy and resultant acreage assumed for development purposes.

It is entirely possible to input other assumptions that have much more fidelity to actual state policies (such as Zero Net Energy buildings and the Governor's goal of reducing building energy consumption by half), and actual technology and market trends (such as decreasing costs of solar panels and increasing utility rates), and derive no need at all for DRECP renewable energy

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[16] STATE ALTERNATIVE FUELS PLAN, California Air Resources Board California Energy Commission, December 2007, CEC-600-2007-011-CMF, p.66.
[17] Draft DRECP, Appendix F3, p. 6.
[18] Ibid, p.9-10.

development using the same calculator. The Executive Summary states that the 20,000 megawatt target limitation for renewable energy in the DRECP area is 20 percent more than the calculated need. But there is no justification for making such a claim without the calculator. Thus, the calculator must be seen not as a passive "catcher's mitt,"[19] but rather as a crucial tool that is central to determining the fate of hundreds of thousands of acres in California's desert, in attempting to provide the justification for a specific numerical cap on the amount of utility-scale renewable energy development in that region.

This mischaracterization of the calculator's inputs and its role in determining the scope of renewable development in the desert, as well as the lack of full transparency of calculations, is unfortunately also carried through into numerous inconsistencies and inaccurate statements about quantitative assumptions and results. For example, explicit modeling of the number of acres per megawatt leads to a very different value for the total acreage footprint than what is presented in the executive summary, which uses a different footprint methodology. Specifically, the total acreage identified in the Executive Summary for development of the Preferred Alternative is about 177,000 acres[20] but in a later volume of the document, at Table II.3-20 the total project areais revealed as actually 297,000 acres. The difference is that in the Executive Summary, only roads and the areas around the base of each wind turbine are counted as acreage impacted by wind projects, whereas the entire project areas of wind facilities are reflected in the more accurate figures found at Table II.3-24. The areas per megawatt assumed in the calculator model are shown in the table below. [21].

Table F1-1
Acreage Requirements per MW of Generation Capacity

Technology	Acres/MW
Central station solar thermal	7.1
Central station solar PV	7.1
Wind	40
Geothermal	5.0
Utility-scale distributed generation	7.1

However, the typical reader will never understand this change because the methodology in the Executive Summary is not shown in an explicit calculation; and the explanation in the footnotes obscures what exactly has been done and how many acres of actual footprint are hidden from view in the main section of the document that most people might actually read. They will walk away with the impression that far less acreage will be developed in these Alternatives than is actually intended.

Similarly, the earlier iteration of the DRECP calculator (distributed to stakeholders for the July 25, 2012 meeting used a different assumption for capacity factor for geothermal power (85%) than is shown in the MW and MWh tables in Appendix F2 (58%). These inconsistencies are

[19] Ibid, p.3.
[20] Draft DRECP, Executive Summary, Table 7, Summary of the Draft DRECP Alternatives; line item showing "Total estimated footprint impacts (all RE technologies and transmission)", p.40.
[21] Draft DRECP, Appendix F1, p.7.

compounding, and make it nearly impossible to reconstruct an accurate picture about the relationship between the 20,000 MW target limit and the determination of need based upon the input assumptions.

Also, the presentation of the calculator in the plan states that the July 2012 scenario is “fully consistent” with the most recent forecast.[22] Yet the following section in the plan’s Appendix F3 shows that this cannot be the case, since the 2014 to 2024 demand forecast was not published until January 2014, a year and a half after the July 2012 scenario was submitted.[23] The demand forecast available in 2012 was not only years older; the entire character of the demand forecast subsequently changed because it added data tables for Additional Achievable Energy Efficiency which the Energy Commission had not produced previously. Furthermore, even the 2014 to 2024 forecast is no longer the Energy Commission’s most recent, since there is now an update that goes one year further out, to 2025, and also has valid historical baseline demand data for 2012 and 2013 that would have only been a forecast in July 2012. Therefore, none of the analysis is consistent with the most recent forecast, because the most recent forecast is completely left out of consideration. As discussed in the next section, this omission is significant, and is yet another factor that inflates the DRECP’s estimate of need for renewable energy in the desert.

A *reasonable* DRECP plan should be built on assumptions that are consistent with meeting the policy objectives for which it is created. It should also be consistent with the full range of policy objectives laid out by the state for this same purpose. In addition, the assumptions should be based on the most recent and best available data and analysis, including projections for energy supply and demand, which are only modified when there is reasonable justification. It should use clearly defined assumptions that are consistent and transparent throughout the plan. And a reasonable Desert Renewable Energy Conservation Plan should serve, to the greatest feasible extent consistent with the climate protection goal, its intended purpose for protection and conservation of the desert.

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[22] Draft DRECP, Appendix F3, p.8.
[23] Ibid, p.15.

B. Energy Demand Projection

Key Points; DRECP should:

- Clarify that subsequent "scenarios" render older iterations obsolete, due to improved data
- Use the most recent California Energy Commission 2014 Update demand forecast
- Correctly account for Additional Achievable Energy Efficiency (AAEE)
- Account for publicly-owned utilities' additional efficiency, excluded from AAEE
- Provide all assumptions used when extrapolating from official state forecasts out to 2040 as well as the corrected spreadsheets.

1. Energy Demand Projections are Inconsistent and Inaccurate.

The draft DRECP Appendix F3 describes how the calculator evolved over time. The successive configurations and assumptions and results are broadly referred to as scenarios. Yet the text claims that the third iteration, referred to as the "July 2012 scenario," is "fully consistent with the latest (sic) Energy Commission's most recent ten-year energy demand forecast (*California Energy Demand 2014 – 2024*)". The text also points out that the techniques used in the technical modeling history include "adaptive management techniques such as reiterative refinement…." Given these claims, the plan should also make clear that these are not simply different scenarios that may be considered as having roughly equal standing, but rather that the subsequent "scenarios" actually replace the previous ones because they include corrections. In this sense, the framing idea repeated in this section that these scenarios are merely "possible futures," as though all scenarios should be treated as equally valid for the purposes of the DRECP plan, needs to be qualified. And the July 2012 "scenario" should more accurately be called the July 2012 "revision" or "update."

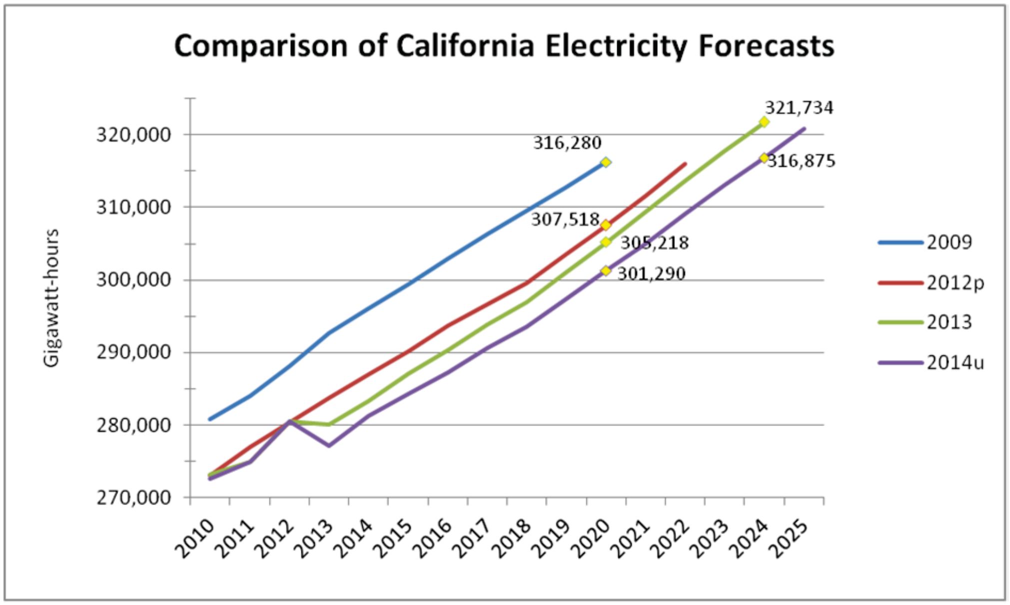
While most of the discussion regarding revisions to the scenarios is accurate, it leaves out some very important quantities that were important to the development of the model, and there are inaccuracies in the narrative regarding the demand forecast. As previously noted, the ten year demand forecast for 2014-2024 cannot be fully consistent with the July 2012 update, because the forecast was produced a year and a half later. Furthermore, the comments Sierra Club submitted in January 2012, in response to which the July revision was made, referred to the 1.2% per year growth rate in the Energy Commission's *2009 demand forecast*. The most recent forecast available in July 2012 was the preliminary 2012 to 2022 forecast produced in February 2012, a month after Sierra Club's first round of comments.[24] Even the 2014 to 2024 forecast is not the most recent, since an even newer forecast has been produced for 2015 to 2025.

Thus, the claim that the July 2012 scenario is "fully consistent with the latest Energy Commission's most recent ten-year energy demand forecast (*California Energy Demand 2014 – 2024*)" contains *multiple false assertions*, since the demand period of 2014 to 2014 is not the most recent forecast, and the July 2012 scenario cannot possibly be fully consistent with either of the newer forecasts since these had not yet been produced. The subsequent narrative in the plan appendix F3 even shows exactly why the July 2012 scenario was not consistent with the next

[24] http://www.energy.ca.gov/2012_energypolicy/documents/index.html#02232012

Energy Commission forecast, with the net result of a further necessary downward revision in the 2040 fundamental demand by about 8,000 gigawatt-hours to 328,000 gigwatt-hours.

The following charts illustrate the systematic errors, due to the fact that every new Energy Commission forecast results in a significant reduction in projected future demand.



This chart also shows why it is important to use the most recent 2014 California Energy Demand Update (labeled 2014u) and why DRECP's use of any of the previous forecasts is seriously obsolete. By 2020 the newest forecast is 4,000 gigawatt-hours lower than the 2013 forecast—which is where the draft DRECP narrative concludes—and the difference increases over time such that by 2024 the gap is 5,000 gigawatt-hours. The gap is even larger when measured against the 2012 preliminary forecast (2012p), which was the most recent available when the July 2012 update "scenario" was produced.

While some people may consider a 5,000 gigawatt-hour reduction to be a minor "tweak" to the demand forecast, some context can show why this is not correct. This reduced demand directly offsets the need for renewable energy generation to reach a given carbon target, since renewable energy and reduced demand are both zero carbon "resources." This table shows that nearly 1700 megawatts of wind power would be avoided by a 5,000 gigawatt-hour decrease in demand, which also means needing 67,000 acres less for wind energy development.

Wind Energy Generation and Area

Capacity	1,679	MW
Capacity Factor	34%	
Generation	5,000	GWh
Land Intensity	40	acres/MW
Area	67,152	acres

2. Energy Efficiency Assumptions do not Match the CEC's own Projections.

The second version (October 2011) of the DRECP model had three values for the annual rate of energy efficiency savings, a "high value" of -0.934% per year, a middle "selected value" of -0.834% per year, and a "low value" of -0.734% per year.[25] These values are negative because they are subtracted from the underlying "unmanaged" growth rate for electricity demand. The DRECP spreadsheet model originally assumed a baseline growth rate of 1.5% per year between 2010 and 2040, and this was partially offset by efficiency savings of -0.83% per year, resulting in a net growth rate of 0.67% per year. These original values were based on historical data from 1990 to 2010, rather than the Energy Commission's current forecast.

In response to comments from Sierra Club and others, in the third iteration of the DRECP model (July 2012), staff produced an estimate of demand growth for DRECP based upon the Energy Commission's official forecast, adopting the recommended methodology of removing the demand for electric vehicles from the official forecast to avoid double counting, since the DRECP model adds in electric vehicle demand separately.[26] The result was an "electric-vehicle-free" demand growth rate of 0.998%, which was reduced by estimated additional efficiency to a net growth rate of 0.486%—implying efficiency savings of 0.51% per year.

However, staff *removed* 0.1% from the efficiency savings rate, decreasing the efficiency savings to 0.41% per year, and increasing the net growth rate to 0.586% per year to account for a vague "uncertainty," about the pace of energy efficiency deployment after the initial period of 2012 to 2020 included in the commission's 2009 forecast. This halved the DRECP's original assumed value, and implied an energy efficiency savings of only 0.41% per year. The arbitrarily large reduction of efficiency savings almost exactly offset the effect of reducing the growth rate from 1.5% to 0.998%. One step forward; one step back. Moreover, the selective application of dramatically reduced efficiency savings to the July 2012 revision turned out to be substantially inconsistent with future demand forecasts from the Energy Commission.

The DRECP value for energy efficiency should not be based upon arbitrary assumptions created ad-hoc for this plan. Rather, it should build upon the Commission's own efficiency forecast. The 2014 update to that forecast included values for both a base case without Additional Achievable Energy Efficiency (AAEE), and another base case with the additional efficiency. By putting the demand series together it is possible to reconstruct the amount of AAEE otherwise obscured by splitting the forecast up in this manner.

However, the official AAEE only accounted for projected efficiency savings from the three large investor owned utilities; it did not include any value for the publicly-owned utilities (POUs) such as LADWP and SMUD. This effectively leaves out all additional efficiency from markets

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[25] 2040 and 2050 Acreage Needs for Renewable Generation, Dave Vidaver, Electricity Analysis Office, California Energy Commission, Oct. 21, 2011.

[26] Desert Renewable Energy Conservation Plan: Renewable Energy Acreage Calculator and the 2040 Revised Scenario's Renewable Portfolio, June 20, 2012

representing about a quarter of the state's electricity sales. This is a significant omission because SMUD is well known to have excellent efficiency programs and LADWP has recently increased its efficiency goals and funding, and these are the two largest POUs.

While Sierra Club requests that the Commission include the POU AAEE in the next demand forecast, the commission's Net Short report[27] did include a figure for the POUs of 4760 gigawatt-hours of additional savings by 2024. Sierra Club used a linear interpolation into the Commission's 2014 forecast update to derive a trend line for combined IOU plus POU AAEE. The following table shows these values for the period 2013 to 2025.

Energy Commission Base Case Statewide Electricity Consumption Forecast

(values in gigawatt-hours; annual growth rates in right column)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Consumption (No AAEE)	277,140	281,195	284,305	287,311	290,587	293,625	297,419	301,290	305,080	309,152	313,055	316,875	320,862	1.228%
Total Consumption Less EV (No AAEE)	276,938	280,936	283,787	286,405	289,242	291,883	295,160	298,465	301,660	305,087	308,315	311,497	314,754	1.072%
Total Consumption Less EV w/AAEE	276,938	280,536	281,450	281,792	282,453	283,255	284,579	286,138	287,460	288,945	290,075	291,143	292,046	0.444%
POU EE	-	(400)	(800)	(1,200)	(1,600)	(2,000)	(2,400)	(2,800)	(3,200)	(3,600)	(4,000)	(4,400)	(4,800)	
Net Consumption	276,938	280,136	280,650	280,592	280,853	281,255	282,179	283,338	284,260	285,345	286,075	286,743	287,246	0.305%
Total EE		(800)	(3,137)	(5,813)	(8,389)	(10,628)	(12,981)	(15,127)	(17,400)	(19,742)	(22,240)	(24,754)	(27,507)	-0.767%

The table uses a similar method to the July 2012 revision of the DRECP model, which is to subtract embedded electric vehicles from the basic forecast, and then subtract the additional efficiency savings. However, this table is different in two important ways from the method used to date by DRECP:

1. The baseline value is total energy consumption rather than Net Energy for Load.
2. The table then subtracts POU additional efficiency

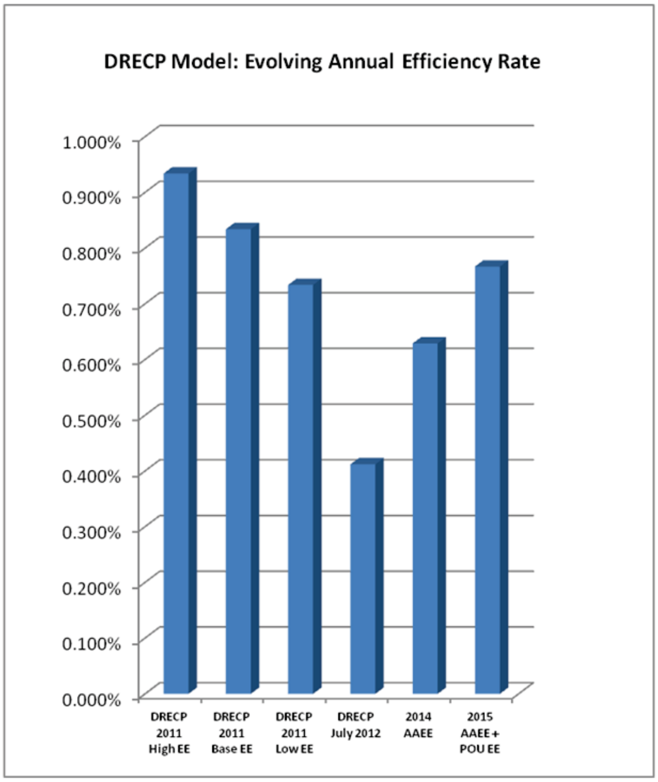
It is better to start with energy consumption because net energy for load is not a fundamental value. Net energy for load is actually a value in between total generation and total consumption. If you start with total generation, then it is necessary to subtract self-generation to get net energy for load. If you start with consumption, then it is necessary to add back line losses to get total generation, then subtract self-generation. Basically, net energy for load is what the utility has to produce or purchase from power generators after accounting for what people generate for themselves. The problem is that the growth of self-generation slows down the growth of (or may even shrink) utility-supplied electricity (net energy for load), compared to the actual total production of electricity—which equals utility generation plus self-generation by customers.

Mr. David Vidaver, who served as staff for the DRECP energy modeling, produced a spreadsheet for Sierra Club in January 2015, which started from net energy for load and then had to go backwards through the first process above in order to derive total consumption, and then to produce valid results for growth rates. It is far simpler to take total consumption to begin with, and simply subtract electric vehicles (to avoid double counting in the DRECP model). The consumption values can then be converted to total electricity generation by adding back the line losses, and the resulting total generation value directly entered into the spreadsheet model, with appropriate changes of the labeling. Sierra Club recommends this change in the spreadsheet model, as well as insuring that a correctly filled in spreadsheet is included with the EIR/EIS

[27] Add cite: net short spreadsheet

package. The values from this spreadsheet should then in turn be consistent with values that appear in the DRECP documents.

The result of the above recommended method is a combined IOU + POU statewide additional energy efficiency savings rate of -0.767% per year, which is very close to the base case efficiency rate of 0.836% per year originally used by the 2011 version of DRECP model. The following chart illustrates the evolution of the efficiency rate, and shows Sierra Club's reconstruction of the most recently available values for additional efficiency, based upon data from the Energy Commission, with the far right column.



The left three bars show the "high value," middle "selected value," and "low value" for energy efficiency (EE) savings in the October 2011 iteration of the spreadsheet model, which were subtracted from the 1.5 percent per year assumed underlying growth rate that would have occurred without these efficiency savings. The 1.5 percent rate was based upon historical data from 1990 to 2010.

The chart above clearly illustrates how the July 2012 "scenario" update reduced the efficiency rate in half, and how systematic reconstruction of the Energy Commission forecast data in 2014, and then with further corrections in 2015 (the two bars on the right) restores the efficiency rate back to within the original range of assumptions. This increased efficiency savings significantly reduces the resulting growth rate, and therefore the demand projection, out to 2040.

Since the Energy Commission's demand forecast only extends out into the 2020s, it is necessary to make an extrapolation out to 2040. While weather and economic fluctuations affect demand on a year to year basis, the fundamental driver of long-term changes of electricity demand in California is population. It turns out that the rate of population growth in California is slowing down significantly, and this is a major long-term demographic phenomenon that is expected to extend at least to 2060, which is as far as current forecasts attempt to project.

Mr. Vidaver also provided Sierra Club with population data used by the Commission to produce the high, base, and low cases in the official electricity demand forecast. Global Insight supplied the population data series used to produce the Commission's base case forecast, and the base case forecast has consistently been used by the DRECP model. Sierra Club recommends that for this reason, the Global Insight population series—which extends to 2040 and beyond— should be used to extend the electricity forecast. This should be accomplished through the following steps:

1. The basic electricity demand growth rate in the Commission's 2014 Update forecast, prior to additional efficiency, is 1.23 percent per year;

2. Subtract electric vehicles from the demand in order to derive an "electric-vehicle-free" demand growth rate; in this case 1.07 percent;

3. Since the Commission's forecast only goes out to 2025, apply the population adjustment factor, which is equal to rate of population growth during the energy forecast period (2013 to 2025) compared to the population growth of the full period out to 2040 (2013 to 2040)

4. Subtract the Additional Energy Efficiency savings from the Commission forecast

5. Subtract the energy efficiency savings rate from Publicly Owned Utilities.

The Global Insight population series comparing these two periods shows it is necessary to lower the fundamental demographic growth rate in electricity demand to 91.56% of the growth rate to 2025—after electric vehicle demand has been removed. Then the efficiency savings would be applied. The following table shows the results:

Adjustments Needed to DRECP Model: Adjustments to Demand Growth
Using CED 2014 Update & POU Efficiency

	Basic Demand Growth Rate	1.23%
-0.156%	EV Adjustment	1.07%
91.56%	Population Adjustment to 2040	0.98%
-0.629%	AAEE Adjustment	0.35%
-0.139%	POU EE Adjustment	0.21%

The percentage values in the left column show the factors that change the value in each line; the right column is the resulting growth rate after that factor is accounted for. For example, in order to account for removing electric vehicles from the Basic Demand Growth Rate of 1.23% it is necessary to subtract -0.156%, resulting in 1.07% growth rate left over at that point in the calculation.

The table below applies the net growth rate of 0.21% per year just calculated to the total electricity consumption reported by the Commission's forecast for 2013, the base year for the growth calculation. The 0.21% growth rate is extended for 27 years out to 2040, which results in a demand that is 1.06 times (i.e., 6 percent higher than) electricity consumption in 2013. Then the line losses are added to consumption in order to get back to total electricity generation.[28]

Revised Projections to Correct DRECP Model: Electricity Demand and Generation to 2040
After subtracting electric vehicles and energy efficiency (Gigawatt hours)

Initial Demand (2013)	276,938
Target Date	2040
Years	27
Target Year Demand Factor	1.06
Target Year Demand	293,434
Line Loss	7.50%
Factor	1.081
Initial Year Generation	299,392
Target Year Generation	317,226

The analysis presented in the plan appendix results in 328,000 gigawatt-hour demand, but correcting the current DRECP model as described above shows generation at about 317,000 gigawatt-hours in the 2040 target year. This requires a further 11,000 gigawatt-hour reduction in the demand projection shown as the ultimate result in the DRECP plan.

It is important to note that the 317,000 gigawatt-hour demand in 2040 is simply a correction to the assumptions used by DRECP to 1) include Public Utility Additionally Achievable Energy Efficiency savings that were omitted, using CEC data to do so, and 2) correct the extrapolation of the demographic growth rate out to 2040 consistent with the most current Energy Commission demand forecast. It does not involve new or greater energy efficiency assumptions that would be inconsistent with extrapolating current state forecasts.

3. Other Policy Factors that Might Affect Future Demand for Electricity.

The analysis accompanying the draft Plan's appendix acknowledging the asserted 328,000 gigawatt hour generation in 2040 (which, although lower than the earlier DRECP estimate, is 11,000 gigawatt inflated) is followed by brief commentary regarding factors that could increase or decrease this value. [29]

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[28] The formula for adding back the line loss = 1 / (1 – line loss of 7.5%) = 1.081 times the consumption.
[29] Draft DRECP, Appendix F3, p.19.

> The adjustments to and extrapolation of *CED 2014 -2024* demand forecast as above fails to consider factors that do not have an effect on demand over 2014 – 2024, but are expected to have an impact during 2025 – 2040. The development and deployment of new energy efficiency technologies, encouraged by continued expenditures on energy efficiency programs and higher retail electricity prices will encourage energy efficiency savings while electrification of residential and commercial space and water heating, as well as the electrification of industrial processes that currently directly combust fossil fuels, will contribute to growth in electricity demand.

The concept of moving all natural gas use to the electricity sector is a new element that was never contemplated in previous iterations of the model, and there has been no effort to analyze the significance of such an idea. There is no current state policy to replace natural gas with a sector-wide electrification, and more importantly *developing a comprehensive plan* for such a conversion was far outside the scope of DRECP activities to date and was never discussed or analyzed elsewhere in the document. It simply does not make sense to move existing appliances to electricity without a major effort to improve efficiency at the same time.

A brief examination shows that massive electrification of natural gas consumption, other than in limited cases where there is no other good option, is a poorly conceived move from the perspective of efficiency or climate protection. First we note that the DRECP spreadsheet model does not represent a completely carbon free electricity supply portfolio; it includes about 120,000 gigawatt-hours of natural gas generation. Currently, electricity generation is by far the largest use of natural gas in California, taking up 45 percent of the state's natural gas usage. Electricity generation with natural gas ranges from 35 to roughly 50 percent efficiency, give or take a few percent. This compares with natural gas home water and space heaters which approach 80 percent efficiency. Conversion of domestic natural gas to electricity that is powered by natural gas results in a huge loss of efficiency. Therefore, domestic natural gas reduces natural gas consumption by half compared to using natural gas to generate electricity.

Unfortunately for this strategy, the matter of electrification of natural gas does not improve when we get electricity from renewable energy. For example, if we put a solar photovoltaic panel on a roof, solar energy is converted to electricity at about 15 percent efficiency, and then uses the solar electricity to heat water. The much smarter move would be to replace the solar photovoltaic panels that would be used for heating water, and install a solar hot water heater, which collects solar energy at 40 percent or higher efficiency. This makes a rooftop into a much more efficient solar energy conversion system, and makes much better use of limited rooftop space. Then the balance of the available rooftop space can be reserved for solar photovoltaics for a limited amount of thermal energy and non-thermal applications.

While some electrification of the natural gas sector may take place, current policies seem to be moving in other directions. For example, the Million Solar Roofs program was supplemented by a program for installing solar hot water heaters. Furthermore, just as there are electricity efficiency programs and funding, there are parallel programs for energy efficiency in the natural gas sector. It is also likely that policies like Zero Net Energy buildings and the Governor's proposed plan to reduce building energy use by 50 percent would tend first to greatly reduce natural gas use, and then to produce onsite energy to serve this need. One of the elegant features of onsite renewable heat—such as solar hot water, solar space heating, geothermal heat, and other renewable sources—is that the heat can be readily stored in or near a building using water tanks or other thermal mass.

The effect on demand will be quite large if these efficiency policies are implemented. The following table shows the sum of residential and commercial demand in 2013, according to the Energy Commission's most recent forecast—the 2014 Update. This energy conservation policy would eliminate about 30 percent of California's total electricity demand by 2030; this compares with only 15 percent efficiency savings by 2040 that is assumed in the DRECP model.

Effect of 50 Percent Reduction of
Residential and Commercial Electricity Use

Sector	Gigawatt-hours
Residential	87,527
Commercial	103,862
Total	191,389
Half Reduction	(95,695)
Net Demand	95,695

The reduction of demand in existing buildings would complement the Zero Net Energy (ZNE) building policy for new construction. The ZNE policy, though which all new residential construction should be zero net energy by 2020, and all new commercial construction zero net energy by 2030, means that there would be little to no growth in grid electricity demand after 2030. As shown in the next section, it would also mean a lot more distributed on-site renewable generation than is reflected in the DRECP model.

C. Energy Supply

Key Points; DRECP should:

- Use the best available data for basic demand forecast to rebalance energy supply
- Correct the projection for "rooftop solar" self-generation
- Correct the values for existing zero carbon resources
- Rebalance resource portfolio to determine DRECP need
- Compare existing DRECP resources to Preferred Alternative
- Correct acreage and other assumptions

1. Corrections of California Energy Supply Projections

Demand Forecast: The corrected values for electricity demand should be entered in the spreadsheet tool in order to rebalance the electricity supply portfolio, using the same methodology DRECP adopted for the July 2012 "scenario" update, but applying the following three corrections:

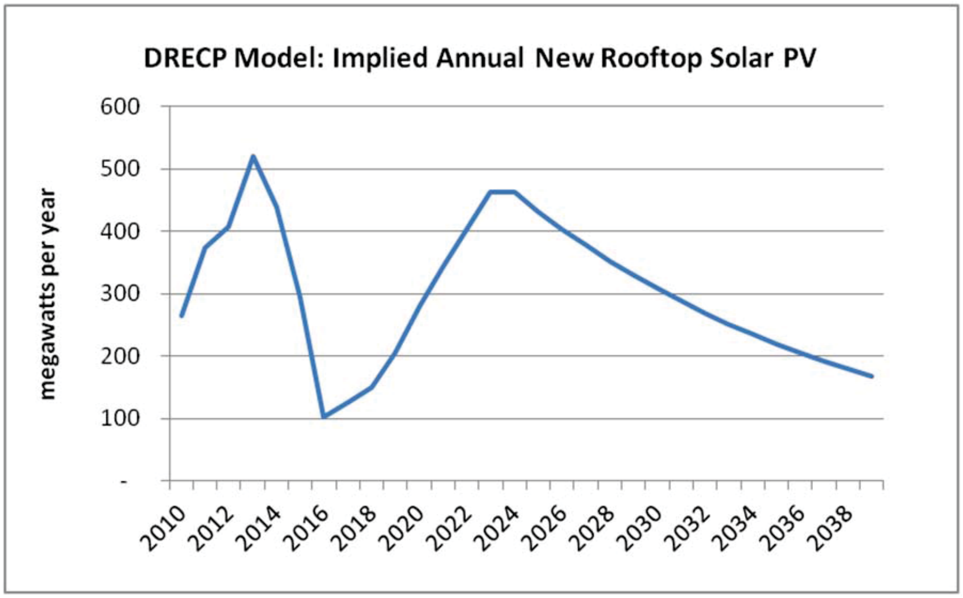
> 1. Use the Energy Commission's *most recent California Energy Demand Update* (CEDU 2014); the draft DRECP claims to be using the most recent forecast is not correct;
>
> 2. Use the *correct population forecast* (Global Insight) that is used in, and therefore consistent with, the Commission's base case forecast, using population growth figures *for the same periods* that are being considered in the extrapolation to 2040—the CEDU population growth for 2013 to 2025 as a ratio to the full period of population growth from 2013 to 2040; analysis of maximum and minimum growth rates for various shorter periods of time, as in DRECP Appendix F3 analysis, is interesting, but it is not consistent with the full time periods being compared, and it is not clear what the logical implications of this variability are: are these short term fluctuations due to "uncertainty" or are they due to historical demographic factors (such as when previous generations reach peak child bearing age) that "even out" over a longer timeframe;
>
> 3. Factor in the Energy Commission's best data for *Publicly Owned Utilities additional efficiency* that was not embedded in the forecast;
>
> 4. Use values for total generation rather than net energy for load, combining both self generation and utility generation together, which is also consistent with the most recent approach in the DRECP analysis.

Sierra Club's construction of these calculations results in a value of 317,226 gigawatt-hours for total generation; as stated above, we recommend using total generation rather than "net energy for load." Compared to the population-adjusted figure of 328,087 gigawatt-hours in the draft DRECP,[30] this is a further reduction of about 11,000 gigawatt-hours.

Rooftop Solar Photovoltaics: The draft DRECP also makes arbitrary—and dramatic—reductions after 2025 to the most recent Energy Commission forecast for customer sited photovoltaic generation. This is certainly not consistent with the data, and the downward trend

[30] Draft DRECP, Appendix F3, p.19.

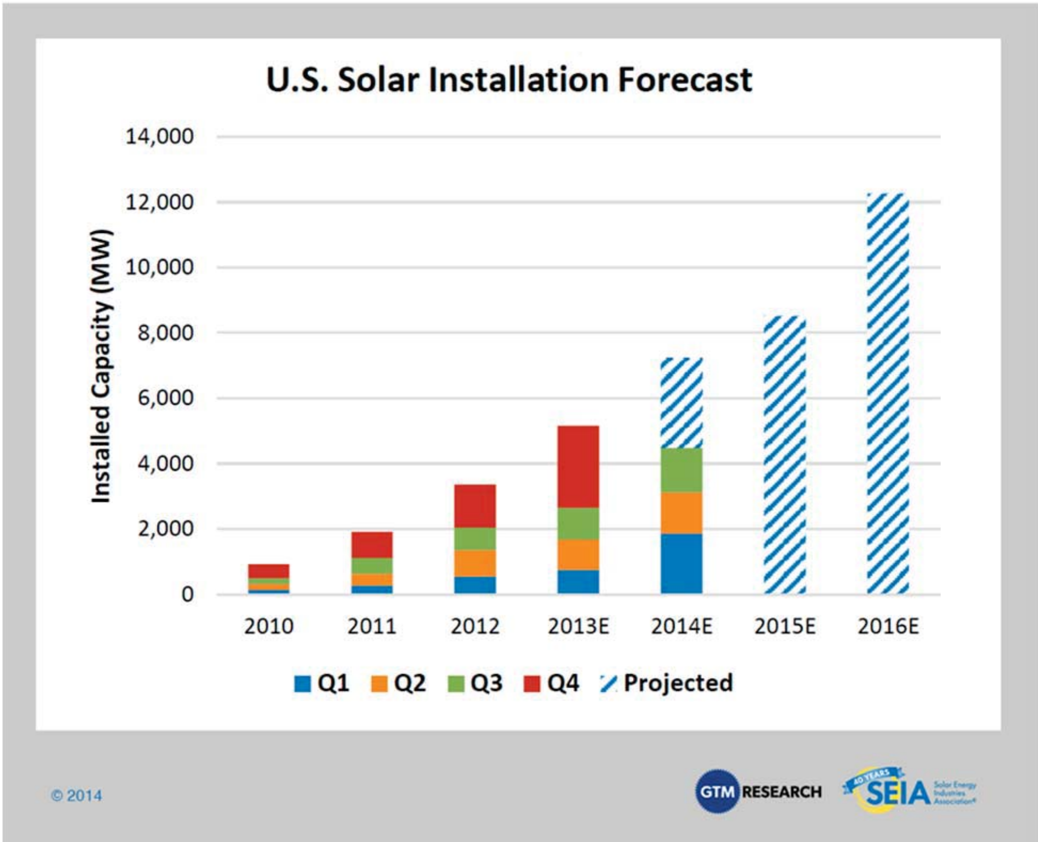
after 2025 is not explained in the text. Here again is the chart shown in the earlier section of Sierra Club's comments that illustrates the radical discontinuity in the trend line for growth of "rooftop solar" photovoltaics after 2025. The values shown up to 2025 reflect the Energy Commission's data; the values after 2025 represent an extrapolation that results in a cumulative 10,000 megawatts of net metered "rooftop solar" in 2040. The draft DRECP never disclosed the data for how they envisioned the rooftop solar market to evolve over time, so this is one possible construction that is consistent with DRECP's assumptions for a cumulative 3000 megawatts in 2017 (at the conclusion of the Million Solar Roofs program) and 10,000 megawatts in 2040.



The unaccounted shrinking of the rooftop solar is not consistent with long-term trends for increasing utility rates and decreasing cost of solar PV. Furthermore, a simple visual inspection shows the inconsistent character of the trend line. The reduction in annual demand between 2013 and 2016 is probably accounted for by the Commission staff believing that the phase down of rebate rates from the Million Solar Roofs program would radically dampen demand for rooftop solar.

However, contrary to the Energy Commission, the solar industry (SEIA) and GTM Research are forecasting continued growth in the United States, with California being the largest market.[31]

[31] http://www.seia.org/research-resources/solar-industry-data



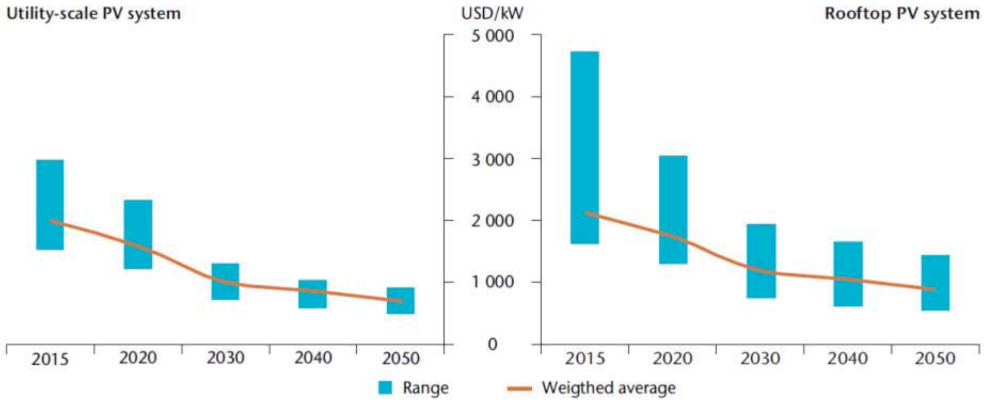
The market in the year following 2016 has uncertainty, because the 30 percent federal solar investment tax credit is currently due to expire in 2017. The Obama Administration has recently signaled support for renewing the credit, and the solar industry is making this a priority.[32] Analysts in the industry actually see much more adverse effect on utility scale installations than for commercial and residential installations, because the "rooftop" market is partly driven by factors other than a strict accounting of rate per kilowatt-hour, such as concern for the environment, desire for energy self-reliance, and a general expectation that utility rates will increase in the future. Furthermore, even if it is not renewed, the tax credit will go down to 10% rather than zero for the commercial sector.

At the same time, there is strong evidence that there is much more room for price reduction in all solar photovoltaic markets that is sufficient to offset most, if not all, of the loss of the tax credit. Historical data showed that residential photovoltaic systems in the United States cost an average of $4.69 per watt-dc in 2013, but a bottom up analysis including parts, installation and profit implied a total cost of $3.74 per watt-dc—and this was for the fourth quarter in 2012. The bottom up cost is at least 20 percent lower than the reported cost, showing that removal of the tax credit could very likely be accommodated by the market through price reductions that offset

[32] Obama Budget Aims to Make Solar and Wind Incentives Permanent, Eric Wesoff, Greentech Solar, February 2, 2015. http://www.greentechmedia.com/articles/read/Obama-Budget-Aims-to-Make-Solar-and-Wind-Incentives-Permanent

most of this loss. Reported costs in California were higher than average in the U.S at $4.94,[33] suggesting an even larger possibility for price reduction, particularly since current installed costs of rooftop solar in Germany, Great Britain, and Australia are 40 to 50 percent lower than in California. Current forecasts by the International Energy Agency show rooftop solar photovoltaics decreasing dramatically in price at least out to 2050.[34]

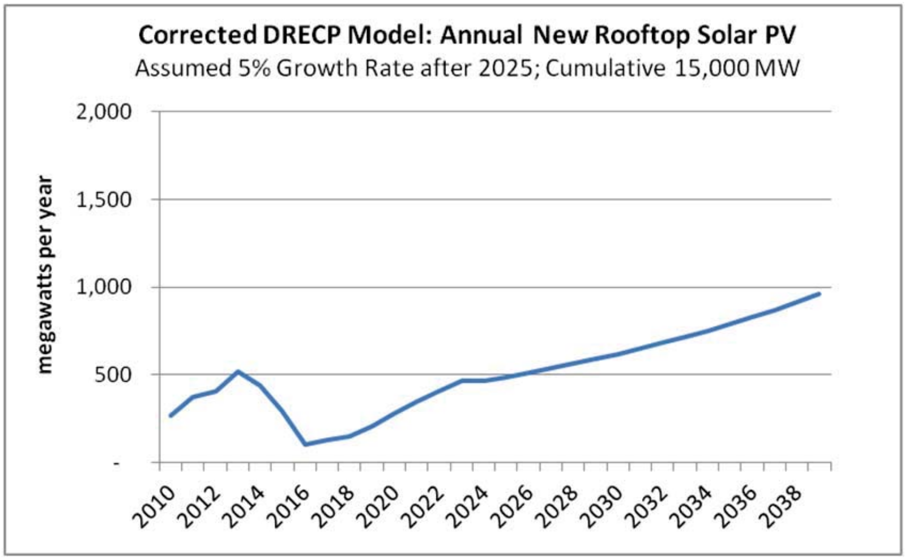
Figure 11: PV investments cost projections in the hi-Ren Scenario

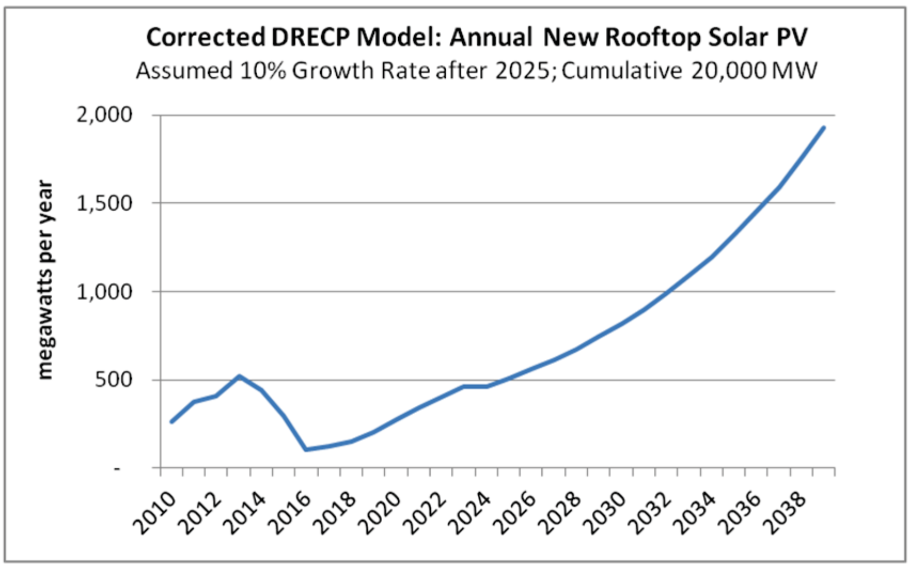


KEY POINT: The price ranges of PV systems will narrow, and the average cost will be halved by 2040 or before.

The following two charts, created by Sierra Club, allow visual inspection of likely paths to the two alternative scenarios proposed in the draft DRECP for rooftop solar in California, reaching 15,000 megawatts and 20,000 megawatts in 2040. As in the previous chart, the Energy Commission data is used up to 2025, then a fixed growth rate is applied out to 2040. The upper chart uses a 5 percent annual growth rate after 2025 which cumulatively reaches 15,000 megawatts by 2040, while the lower chart uses a 10 percent annual growth rate after 2025 which reaches a cumulative installed capacity of 20,000 megawatts by 2040.

[33] Photovoltaic System Pricing Trends Historical, Recent, and Near-Term Projections, 2014 Edition, David Feldman, Galen Barbose, Robert Margolis, Ted James, Samantha Weaver, Naïm Darghouth, Ran Fu, Carolyn Davidson, Sam Booth, and Ryan Wiser, National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory.
http://emp.lbl.gov/sites/all/files/presentation_0.pdf
[34] Technology Roadmap, Solar Photovoltaic Energy, 2014 edition, International Energy Agency, p.23.
http://www.iea.org/publications/freepublications/publication/TechnologyRoadmapSolarPhotovoltaicEnergy_2014edition.pdf





The chart of the above at 5% annual post-2025 growth clearly shows a slowing down of growth, while the chart below at 10% post-2025 growth is more consistent with the trend prior to 2025. Both of these single digit growth rates are much slower than has historically occurred, which can be seen by the comparatively steep angle at the left of the charts after 2010.

In addition to the fundamental forecast, California is planning to implement Zero Net Energy building policies, with all new residential construction being ZNE by 2020, and all new commercial construction ZNE by 2040. This will have a large effect on the rooftop solar market. Sierra Club took the Energy Commission forecast for new households after 2020 and extrapolated this to 2040 using the population forecast.

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Calculation of Residential ZNE Solar PV

The Commission's 2014 demand forecast update shows 13.56 million households in 2020, growing to 14.1 million by 2025. The simple model projects an additional 2.15 million households by 2040, which are estimated to use about 7,000 kilowatt-hours of electricity annually per household.[35] Assuming a 35 percent electricity reduction in a ZNE house would leave 4500 kilowatt-hours each, which is what a 3 kilowatt-ac photovoltaic system would on average produce over a year. Building 2.15 million new 3 kilowatt PV systems would add up to 6,500 megawatts. A calculation of new commercial demand growth after 2030 shows a need for 9,300 megawatts of new rooftop solar photovoltaics, for a total of over 12,000 megawatts of new rooftop solar for new residential and commercial buildings combined.

Estimate of Need for Rooftop Solar for Zero Net Energy New Buildings to 2040

Sector	MW	GWh
New Residential ZNE	6,578	9,796
New Commercial ZNE	5,620	9,355
ZNE Total PV	12,198	20,303

…………………………

The Zero Net Energy Building policies are clearly not included in the DRECP assumptions, since there is rapidly decreasing construction of solar PV after 2025 assumed by DRECP, when the vast majority of new ZNE PV capacity would be built. After 2030, according to Sierra Club calculations, between 600 and 900 megawatts of "rooftop solar" for ZNE new buildings alone would be necessary—not counting the current or future market for existing buildings. The DRECP model assumption is woefully inadequate, since it implies a total annual market after 2030 of only 300 megawatts or less of rooftop solar.

Sector	MW	GWh	Years	Annual MW 2020s	Annual MW 2030s
New Residential ZNE (2020-2040)	6,578	9,796	20	329	329
New Commercial ZNE (2030-2040)	5,620	9,355	10		562
ZNE Total PV	12,198	20,303			
CSI (2007-2017)	3,000	4,993			
DRECP Additional (2017-2040)	7,000	11,651	23	304	304
Total Solar PV NEM	22,198	36,947		633	1,195

The Zero Net Energy policy would build on top of the existing market, and therefore a projection of at least 20,000 megawatts is necessary to maintain consistency with forecasts and state policy. If the market for rooftop solar in California *does not* experience the 80 percent decrease that the

[35] The average household electricity use ranges from 6891 kWh to 7717 kWh, with an average of 7172 kWh for the period between 2010 and 2025. Data source: California Energy Commission, CEDU, 2014, with additional calculation by Sierra Club to derive energy per household.

Commission's forecast shows from 2014 to 2017, then the cumulative amount of rooftop solar could be much higher than 20,000 megawatts by 2040.

Based on the analysis above, the DRECP should not use scenarios for customer side solar distributed generation (CSDG) that assume only 10,000 megawatts of rooftop solar by 2040. This low amount is not consistent with state policy or the current forecasts.

Utility Electricity Resources

The spreadsheet calculator made several assumptions about utility electricity resources that Sierra Club believes should be corrected.

Existing Renewable Energy in 2010 is assumed in the DRECP model to be 35,000 gigawatt-hours per year, all of which is assumed to be produced in state. However, the Energy Commission's System Power Reports show 40,410 gigawatt-hours of renewable energy delivered to California in that year, of which about 3/4^{ths} were produced in California and remaining quarter imported from out of state. Sierra Club notes that this assumption of 25 percent imports is also used in the DRECP model; this is quite consistent with historical data, and continues to apply in more recent years even as the renewable energy supply has increased greatly.

Existing Large Hydropower (Zero Carbon Resource) is assumed in the DRECP model to provide 30,000 gigawatt-hours from in-state hydropower, and another 3,800 gigawatt-hours from out-of-state hydropower. The in-state amount is higher than might be expected in drought, as California has seen in recent years, but close to the long-term average.

Sierra Club requested data for the quantity of hydropower imported from the Pacific Northwest which enters the state as "unspecified power," but this information was not released even to Energy Commission staff. Such secrecy around data—based upon excessive deference to "the market" or "proprietary information"— has impaired analysis significantly, and Sierra Club hopes that California's regulatory agencies can become more transparent about energy production data in a manner that is more consistent with an open, democratic society. It is disappointing to see that even government staff who need this data cannot easily obtain it from other agencies or from the companies these agencies ostensibly regulate without going to great lengths, if they can get the information at all. Unfortunately, this secrecy can have real world consequences in terms of costs to utility customers, and for adequately protecting natural resources and the environment, since uncertainty is used as a justification to burden sensitive habitats with additional infrastructure whether or not it is actually necessary—we simply don't know.

The following data is an attempt by Sierra Club to reconstruct hydropower inferred from public data, and using an input assumption that 50 percent of the unspecified imports from the Pacific Northwest is hydropower. Energy Commission staff have attempted in the past decade to unravel the sources of electricity in the unspecified power, but indicate some uncertainty.[36]

[36] http://energyalmanac.ca.gov/electricity/total_system_power.html

Estimate of Large Hydropower for California

Year	Unspecified NW Imports (GWh)	Est. NW Hydro (GWh)	SW Hydro (GWh)	CA Hydro (GWh)	Total Hydro (GWh)
2009	12,177	6,089	2,099	25,147	33,335
2010	14,978	7,489	1,333	29,315	38,137
2011	28,840	14,420	1,430	36,583	52,433
2012	29,376	14,688	1,698	23,202	39,588
2013	19,750	9,875	2,159	20,754	32,788
Avg. 2009-2013	21,024	10,512	1,744	27,000	39,256

The table takes 50 percent of unspecified NW imports to be hydropower and adds this to the other specified hydropower supplies. An average of close to 12,000 gigawatt-hours of annual hydropower may have been imported between 2009 and 2013, plus another 27,000 gigawatt-hours annual average generated inside California. The DRECP model assumption of a total 33,800 gigawatt-hours of total hydropower is nearly 5,500 gigwatt-hours lower than the average shown above, *even though the historical data in the above table is strongly affected by a few California low hydro years*. DRECP should verify that its assumptions about hydropower are valid.

<u>Energy Storage</u> in the DRECP model is assumed to absorb 15 percent of the state's total electricity supply in 2040. This is a large increase from the original values for 2040 which assumed 10 percent of electricity goes to storage. Apparently, DRECP staff misinterpreted a Sierra Club comment recommending 15 percent storage in 2050 when the (now obsolete) scenarios assumed huge amounts of intermittent electricity from solar and wind. The new revised scenarios have a much lower fraction of solar and wind; Sierra Club estimates that there is only about 25 percent of variable or intermittent electricity in the revised portfolio; so including 15 percent storage would be grossly excessive. Sierra Club recommends that this be reduced by half to 7.5 percent storage, also taking into account that electric vehicles are absorbing over 60,000 gigawatt-hours of electricity—roughly 20% of the state's electricity going to vehicle storage that can also be used to balance wind and solar power. This adjustment reduces electricity needed by about 5,000 gigawatt-hours that would be lost through excessive storage that would be wasteful both in terms of energy and cost.

Below is a summary of the recommended changes to the supply portfolio.

Summary of Recommended Corrections to Utility Electricity Supply Assumptions

Resource	DRECP Value	Proposed Correction	Note
Existing Renewable Energy in 2010	35,000 GWh; all assumed to be in-state	40,410 GWh; including 30,610 GWh in-state; total addition about 5,000 GWh	Consistent with CEC data for 2010 system power[37]
Zero Carbon (i.e., large hydro)	30,000 GWh instate and 3,800 GWh import	Increase total hydro by and 5,000 GWh	Estimated from system power reports
Energy Storage	15%	7.5%; reduced needed energy by ~5,000 GWh	
Total Correction		Approximately 15,000 GWh less resource need	

2. Rebalancing Statewide Resource Portfolio

The combination of correcting the assumptions about demand, distributed generation, and the utility supply inputs requires rebalancing the statewide energy resource portfolio. The revised model accepts reducing the baseline CO2 emissions to 110 metric tons per year in 1990, and removing offsets, although the fact that the model does not incorporate existing flexible compliance mechanisms has been explained, and these could nevertheless reduce the need for renewable energy to levels well below what is currently assumed. Sierra Club is not saying that it necessarily "supports" such alternative mechanisms, merely that purchase of allowances and renewable energy certificates is allowed under current law for the purpose of meeting carbon reduction and renewable energy requirements respectively.

Taking the various corrections above into account would therefore result in significant changes to all of the Scenarios shown in the draft DRECP regarding different levels of customer side distributed generation (CSDG) which is assigned in the DRECP model to "rooftop solar" PV. [38]

[37] http://energyalmanac.ca.gov/electricity/system_power/2010_total_system_power.html
[38] Draft DRECP, Appendix F3, p.21.

Increase in Zero-Carbon Energy Required in 2040 Due to Change in 1990 Baseline, Revised Modeling of GHG Offset Use

Technology	July 2012 Scenario		No Change in CSDG		15,000 MW CSDG Scenario		20,000 MW CSDG Scenario	
	MW	MW in DRECP	MW	MW in DRECP	MW	MW in DRECP	MW	MW in DRECP
CS Solar PV	7,224	5,057	8,224	5,757	7,733	5,413	7,242	5,069
CS Solar Thermal	3,612	3,612	4,112	4,112	3,867	3,867	3,621	3,621
Wind	6,155	3,078	7,007	3,504	6,589	3,294	6,170	3,085
Geothermal	2,998	2,569	3,413	2,925	3,209	2,750	3,005	2,576
Biofuels	2,569	214	2,925	244	2,750	229	2,575	215
Utility-Side DG	9,421	2,591	10,726	2,950	10,085	2,773	9,445	2,597
Customer-side DG	**10,000**	N/A	**10,000**	N/A	15,000	N/A	**20,000**	N/A
Total	41,979	**17,121**	46,408	**19,491**	49,233	18,327	52,059	**17,163**

These new scenarios, in addition to accounting for the change in greenhouse gas modeling, also need to 1) dismiss the 10,000 megawatt customer side DG option as untenable for the reasons already discussed, 2) account for the reduction in demand due to the updated forecast and publicly-owned utility efficiency savings, and 3) correctly account for existing zero carbon resources discussed above, and the error in assuming far too much energy storage.

Another important correction for the table above was that the DRECP model assumes that 25 percent of additional need for utility scale renewable energy is imported. This is another reason why the values need to be put into a spreadsheet, and have the spreadsheet available for the public to allow for validating results.

The following table shows the rebalanced portfolios from the table above for the state and DRECP region renewable energy, using all the corrections recommended in these Sierra Club comments.

Corrected Resource Mix for California and DRECP in 2040

	Mid-DG (15,000 MW)			High DG (20,000 MW)		
Technology	MW	% in DRECP	MW in DRECP	MW	% in DRECP	MW in DRECP
CS Solar PV	6,000	70.0%	4,200	1,500	70.0%	1,050
CS Solar Thermal	3,000	100.0%	3,000	2,500	100.0%	2,500
Wind	6,000	50.0%	3,000	6,000	50.0%	3,000
Geothermal	2,500	85.7%	2,143	2,500	85.7%	2,143
Biofuels	1,500	0.0%	-	1,000	0.0%	-
Utility Side DG	9,500	27.5%	2,613	9,000	27.5%	2,475
Customer Side DG	15,000	0.0%	-	20,000	0.0%	-
Total	43,500		14,955	42,500		11,168

3. Corrections of DRECP Energy Supply and Acreage Projections

Correct Determination of Need

The previous table shows that the actual need determination for renewable resources in the DRECP should be no higher than the range between 11,000 and 15,000 megawatts, and the DRECP table shown in the previous page that calculates the need between 17,000 and 19,000 megawatts is in error and too high. This needs to be corrected both in the F Appendices as well as in the Executive Summary.

Correct Acreage Estimate

The DRECP numbers for acreage will also have to be corrected. The following table shows a calculation of acreage based upon the standard input assumptions for the 15,000 megawatt-DG Scenario. Where the Preferred Alternative would have a true full footprint near 300,000 acres, the corrected input assumptions for energy reduce this to roughly between 175,000 (for the High DG Scenario) and 200,000 acres (for the Mid-DG Scenario).

	Mid-DG (15,000 MW)				
Technology	MW	% in DRECP	MW in DRECP	Acres per MW	Acres
CS Solar PV	6,000	70.0%	4,200	7.1	29,820
CS Solar Thermal	3,000	100.0%	3,000	7.1	21,300
Wind	6,000	50.0%	3,000	40	120,000
Geothermal	2,500	85.7%	2,143	6	12,855
Biofuels	1,500	0.0%	-		-
Utility Side DG	9,500	27.5%	2,613	7.1	18,549
Customer Side DG	15,000	0.0%	-		-
Total	43,500		14,955		202,524
	High-DG (20,000 MW)				
Technology	MW	% in DRECP	MW in DRECP	Acres per MW	Acres
CS Solar PV	1,500	70.0%	1,050	7.1	7,455
CS Solar Thermal	2,500	100.0%	2,500	7.1	17,750
Wind	6,000	50.0%	3,000	40	120,000
Geothermal	2,500	85.7%	2,143	6	12,855
Biofuels	1,000	0.0%	-		-
Utility Side DG	9,000	27.5%	2,475	7.1	17,573
Customer Side DG	20,000	0.0%	-		-
Total	42,500		11,168		175,633

In fact, none of the at least three different estimates of acreage for wind power, which is the resource that occupies by far the largest land footprint, are completely correct. Sierra Club has compiled a list of actual projects and acreage for each of them, and derived a lower footprint for real world DRECP sited wind power than the 40 acres per megawatt used in the DRECP model, but unfortunately hidden in the Executive Summary by an artificially and extremely low number.

For projects that are already operational or under construction, Sierra Club estimates these occupy about 27 acres per megawatt; these acreages are quite low because they are in very high wind resource areas around Tehachapi, and therefore can be compressed in a smaller area. Wind projects only approved may be in less optimal wind sites, so these are closer to 34 acres per megawatt. The total estimate for existing and approved projects is 11,800 megawatts occupying 174,000 acres.

DRECP Projects On-line, Under Construction, and Approved post 2012

Resource	MW	Acres/ MW	Acres
Wind (operational post 2010)	2300	27	62,100
Wind (approved)	1600	34	54,400
Solar (operational post 2010)	4100	7.5	30,750
Solar (approved)	3800	7.1	26,980
Geothermal	0	5	-
Subtotal	11800		174,230

Properly, such a compiling of data should have been done for DRECP, as the existing and approved projects are so large in cumulative megawatts that they have become the defining feature of renewable development in the plan area. These projects are on-line or scheduled to go on-line post-2010, and thus do qualify toward the adopted megawatts limit for the plan.

An effort to use numbers from projects in the DRECP is more valuable than “studies” that make general assumptions based on projects that may not be the same projects as are located in the DRECP.

In summary, DRECP needs to update its list of existing projects that “count” toward the plan target. The table in Appendix F, p. 23, is about a year out of date and in that time hundreds of megawatts of projects have changed status, either to go online, or under construction. This is especially true of solar projects. Out of the 3000 megawatts of wind power targeted in the Preferred Scenario, about 2300 megawatts are already online or under construction. And the over 4000 megawatts of solar power in the DRECP is already at the maximum that should be allowed in the DRECP if the target for 20,000 megawatts of distributed generation is accepted as a planning assumption—as it probably should be. The total project capacity summary above adds up to over 11,000 megawatts and is already the full amount of capacity in a corrected version of the 20,000 megawatts DG scenario. By this set of corrected assumptions, the DRECP implementation is nearly complete.

For this reason, DRECP should include a correct updated project list that includes capacity as well as acreage. Furthermore, there is no need to assume a “discount factor” for projects that are already built or already sited, as these do not need options for siting.

We also urge that DRECP be consistent in its definition of “acreage associated with” the defined target; as written there are places that are unclear about how the limit is defined and focus both on the acreage and the megawatts, whereas in other places the text states that the plan limit is met when the stated megawatts are reached.