

November 4, 2014



**To the Members of the State Water Resources Control Board,**

We, the undersigned residents of California write to you with great alarm and concern regarding the Board's proceedings in the matter of regulating cooling water intake structures under the federal Clean Water Act, §316(b). We are particularly unsettled by the recent comments from a subcommittee of the members of the Review Committee for Nuclear Fueled Power Plants (RCNFPP).<sup>1</sup> These members "[find] that there is no basis for an exemption for Diablo Canyon from the OTC Policy." Instead of a variance, they apparently consider it eminently reasonable that PG&E should be required to spend upwards of billions of dollars in order to mitigate the following estimated environmental damages:<sup>2</sup>

- 710 pounds of fish impinged per year
- 1.5 billion larvae entrained per year

To summarize briefly the core of our position, it is our opinion that wholly insufficient attention has been paid to the fairly obvious tradeoffs inherent in implementing the Board's OTC policy in the case of nuclear power plants. We protest in the strongest possible terms the poor representation the public is offered by the Energy Commission and the Public Utilities Commission in attaching their authorship to these subcommittee comments on the latest report by Bechtel. We consider it a deeply disturbing abandonment of these agencies' duties to promote sound energy and environmental policy on behalf of California's ratepayers and citizens at large. In response, we have affixed our names to a petition disseminated publicly on the Internet<sup>3</sup> in support of the arguments enumerated below. We intend to show why the conclusions of the subcommittee should be flatly rejected as the Board moves forward in this proceeding. Since the title indicates that subcommittee comments are "proposed" comments, we urge CEC and CPUC staff to withdraw their authorship of this sorely misguided and flawed document.

**1. The capital investments, operation and maintenance costs, energy penalty, and environmental impacts associated with retrofitting Diablo Canyon with closed-cycle cooling towers are wholly disproportionate to the scale of the current environmental impacts of once-through cooling.**

Bechtel's latest report makes it quite clear that the cost of retrofitting Diablo Canyon with cooling towers would be a monumentally expensive and cumbersome affair, with a minimum upfront cost of \$7.5 billion dollars for a forced draft, salt-water cooling towers. We do not object to these estimations of the costs; rather, we object to any further expenditure of ratepayer or taxpayer funds on further study of the exact details of these ludicrous proposals. This order of magnitude is quite sufficient to determine that the costs of closed-cycle cooling dramatically exceed the benefits in the case of Diablo Canyon.

In June of 2003, during discussions on the renewal of DCP's NPDES permit, a document was issued by the staff of the Central Coast Regional Water Quality Control Board summarizing their rebuttals or responses to claims made by various parties to the proceeding.<sup>4</sup> Some intervenors "question[ed] the methodology used by

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<sup>1</sup> "Proposed Subcommittee Comments on Bechtel's Assessment of Alternatives to Once-Through-Cooling for Diablo Canyon Power Plant." Page 12.

[http://www.swrcb.ca.gov/water\\_issues/programs/ocean/cwa316/rcnfpp/docs/subbechcom\\_091214.pdf](http://www.swrcb.ca.gov/water_issues/programs/ocean/cwa316/rcnfpp/docs/subbechcom_091214.pdf)

<sup>2</sup> Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling: Final Substitute Environmental Document, State Water Resources Control Board, May 4, 2010, p. 33, Table 2, Estimated Annual Entrainment.

<sup>3</sup> The petition may be viewed here: <http://goo.gl/forms/a9YyNtYHlk> It is still accepting signatures.

<sup>4</sup> "Staff's Rebuttal Testimony for Regular Meeting of July 10, 2003 Pacific Gas and Electric Company's Diablo Canyon Power Plant Renewal Of NPDES Permit." June 20, 2003. Page 2.

Regional Board staff to determine that the costs of alternatives [to OTC] are wholly disproportionate to the benefit to be gained.” The response of the staff was quite telling: “Staff cannot identify an ecological benefit that would justify costs in the billion-dollar range.” We, the undersigned, have come to the observation that the parties in this current proceeding have either failed or neglected to provide new evidence that this conclusion was wrong. If it has been provided, we would greatly appreciate it if someone would point it out to us, as there is quite a long paper trail one must review and digest in order to fully understand every nuance in the history of this proceeding to which we are relatively late comers. It is our general impression that most of the documents produced in this proceeding seem to gloss over the issue with grandiose yet vague statements as to the significance of the impacts. For example, consider these statements cited and made by the subcommittee comments of the RCNFPP:

*“The consensus among regulatory agencies both at the state and federal levels is that OTC systems contribute to the degradation of aquatic life in their respective ecosystems.”*

*“OTC systems... present a considerable and chronic stressor to the state’s coastal aquatic ecosystems by reducing important fisheries and contributing to the overall degradation of the state’s marine and estuarine environments.”*

These statements are followed by a cursory discussion of the figures cited by the subcommittee in the opening to our letter (710 pounds of biomass impinged and 1.5 billion larvae entrained per year). Absolutely no consideration is paid to the incomprehensibility of such a large figure for larval entrainment, such as the high natural mortality of fish in their early stages of life, the numbers of larvae present in the source water body, the return of the nutrients to the source water body through the cooling water return outlet, or natural compensation mechanisms in the recruitment of remaining larvae to the adult population. These pesky issues are conveniently neglected in the combined-cycle’s comments, presumably with the intention that the reader should be impressed into agreement with the combined-cycle’s view of the significance of the impacts by the sheer number of fish larvae entrained.

As a more informative alternative to these crude measures of the environmental impact of OTC at Diablo Canyon, we offer some comparisons for the Board’s consideration. With respect to impingement of adult fish, we would like to direct the Board’s consideration to the scale of commercial fishing in California. According to the latest data available from NOAA,<sup>5</sup> commercial fishers in California harvested 438 million pounds of fish in 2010. The estimated value of this catch was \$187.8 in current, inflation-adjusted dollars.<sup>6</sup> This implies an economic value of the catch to society of 43 cents per pound. Of course, consumers pay significantly more than this for fish at the supermarket, as a result of the cost of preparation, packaging, transport, and refrigeration. As just one example, salmon may be regularly found for sale at \$9 per pound at Safeway; other, less flavorful fish, may be bought for perhaps \$4 or \$6 per pound. Whatever the exact value, the order of magnitude is clear. It is obvious that Californians tolerate and gladly pay for this enormous withdrawal of sea life from California’s waters in order to enjoy the nutritional benefits and delicious taste<sup>7</sup> of killing and consuming fish.

By contrast, Diablo Canyon is estimated to impinge a mere 710 pounds of fish annually. In exchange for this ecological loss, society benefits from roughly 17.6 million MWh in annual electricity generation.<sup>8</sup> The value of this electricity is regularly estimated by energy as the avoided cost of procurement from another source.

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[http://www.waterboards.ca.gov/centralcoast/water\\_issues/programs/diablo\\_canyon/docs/07\\_10\\_03\\_hearing/testimony/071003\\_rebuttal.pdf](http://www.waterboards.ca.gov/centralcoast/water_issues/programs/diablo_canyon/docs/07_10_03_hearing/testimony/071003_rebuttal.pdf)

<sup>5</sup> National Oceanic and Atmosphere Administration

[http://stateofthecoast.noaa.gov/com\\_fishing/welcome.html](http://stateofthecoast.noaa.gov/com_fishing/welcome.html)

<sup>6</sup> Based upon a cumulative inflation of 6.6% between 2010 and the latest quarterly data available from the Federal Reserve: <http://research.stlouisfed.org/fred2/series/GDPDEF/>

<sup>7</sup> The author of this letter would like to note that a portion of this letter was composed while eating approximately a half pound of salmon, which is approximately equal to 25% of the biomass impinged by Diablo Canyon on a daily basis.

<sup>8</sup> 2240 MW net generating capacity \* 8,766 hours per year \* 90% capacity factor.

Simple observance of wholesale market prices will not do: these only reflect the marginal cost of generation (i.e. fuel) for whichever generator happens to be on the margin of the merit order at a given instant. The wholesale price does not reflect the many other costs of building and operating power plants. In particular, building a plant generally requires a long-term commitment from a utility or other power purchaser to a pay a set price often above the wholesale price, in order for the developer to secure financing. According to the latest Avoided Cost Model prepared by a consultant for the CPUC,<sup>9</sup> the average value of energy and avoided fossil emissions in PG&E territory averages \$80.20/MWh. This equates an annual gross economic value of DCPD of \$1.4 billion. Compared to the relatively low economic values for which California hauls fish out of the ocean, exactly how much concern should we seriously ascribe to the fact that Diablo Canyon impinges approximately one pound of fish for every \$2 million in economic value generated? We also note that, unlike California fish consumers, Diablo Canyon returns the nutrients to the source water body.

As to the more abstract and complicated issue of entrainment, rather than simply bandying about a large but otherwise meaningless raw count of larvae entrained, we believe a more informative metric to consider than is area of production forgone (APF). With this metric, it is very simple to compare the area of habitat disrupted by the continued operation of OTC by DCPD to alternatives (such as retrofitting with cooling towers, or other sources of energy entirely). Dr. Peter Raimondi, chair of the UC Santa Cruz Department of Ecology and Evolutionary Biology, provided testimony<sup>10</sup> to the Central Coast Regional Water Control Board in 2003 during consideration of DCPD's NPDES permit in which he discussed at length the value and proper interpretation of this metric:

*“This value represents the area or distance over that [which] would have to be added to the source water body to compensate for the effects of entrainment. I believe this to be the best currency to interpret entrainment loss from a biological standpoint. ... Another way to think about this is that if the loss were concentrated it would represent all the larval production over [an] ... area of suitable habitat.”*

Dr. Raimondi provided a table containing a handful of summary APF statistics for Diablo Canyon's entrainment. We reproduce it here:

| Source                    | Average APF based on mean larval duration  | Average APF based on maximum larval duration |
|---------------------------|--|--|
| Near shore fish           | 9.42 kilometers of coastline               | 30.98 kilometers of coastline                |
| Subtidal and pelagic fish | 5.76 square kilometers of suitable habitat | 11.52 square kilometers of suitable habitat  |
| Crabs                     | Not done                                   | 14.52 square kilometers of suitable habitat  |

Supposing that “near shore fish” inhabit a range extending to 1 kilometer from the shore, these values can be easily summed. In the extreme case, the entrainment of larval sea life by DCPD represents 57 square kilometers of forgone biological productivity. In addition, the physical structure DCPD occupies approximately 3 square kilometers of coastal land.<sup>11</sup> Given an annual net generation of 17.6 TWh, this equates to a combined land and aquatic habitat use intensity of approximately 3.4 km<sup>2</sup> per TWh per year. With this figure, we can compare this rate of habitat disruption to other sources of energy. The graph on the next page from the latest U.S. National Climate Assessment report<sup>12</sup> summarizes the comparison quite succinctly and

<sup>9</sup> Energy and Environmental Economics. “Latest Distributed Energy Resources Avoided Cost Model (July 24, 2012).” [https://ethree.com/public\\_projects/cpuc5.php](https://ethree.com/public_projects/cpuc5.php) As this model is primarily tailored toward distributed energy resources, the benefits of avoided transmission & distribution losses were not included in the avoided cost figure cited above, as Diablo Canyon is a central station generator.

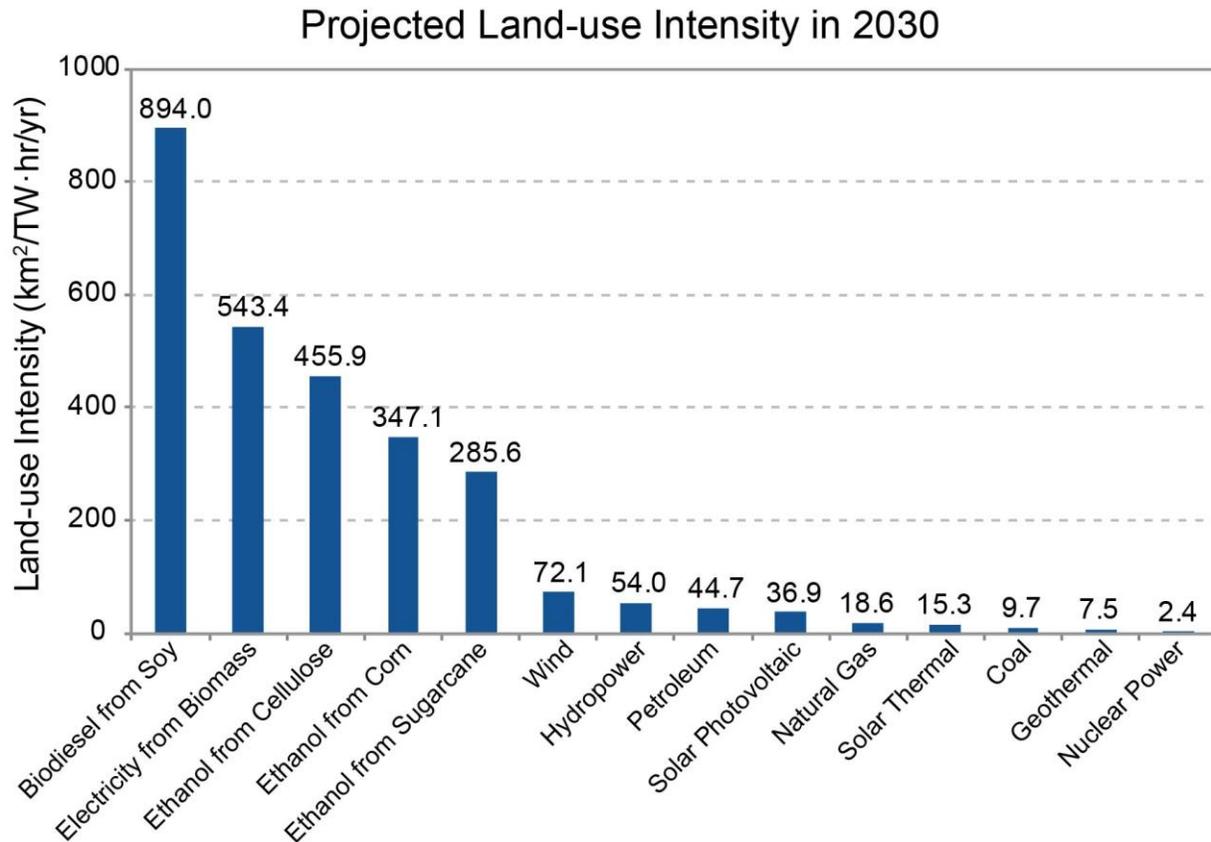
<sup>10</sup> [http://www.waterboards.ca.gov/centralcoast/water\\_issues/programs/diablo\\_canyon/docs/07\\_10\\_03\\_hearing/testimony/071003dr\\_raimonditestimony.pdf](http://www.waterboards.ca.gov/centralcoast/water_issues/programs/diablo_canyon/docs/07_10_03_hearing/testimony/071003dr_raimonditestimony.pdf) Page 4.

<sup>11</sup> <http://www.nrc.gov/waste/spent-fuel-storage/diablo-canyon-isfsi.html#background>

<sup>12</sup> <http://nca2014.globalchange.gov/report/sectors/energy-water-and-land#narrative-page-16463> “Figure 10.6: Projected Land-use Intensity in 2030.”

unequivocally: nuclear power is definitively the single least land intensive source of energy available to mankind. This is a very environmentally beneficial feature of the unrivaled energy density of uranium.

The back-of-the envelope estimate we have provided for Diablo Canyon is highly supportive of the conclusion that—even with the impacts of OTC entrainment considered—continued operation of Diablo Canyon still compares exceedingly favorably to the energy alternatives, both fossil and renewable, when measured by area disrupted per unit of electricity generated.



Source: National Climate Assessment, 2014.

Inevitably, we anticipate that some of the parties to this proceeding will philosophically object to our repeated and vigorous insistence on cost-benefit analysis. They will likely object on the grounds that humans have no right to place monetary values on the welfare of the environment. We are cognizant that we have neither the time nor the patience to debate this point to a sufficient degree that might possibly change any minds on this matter, but we would like to remind every party to this proceeding of the following items:

**A.** In *Entergy v. Riverkeeper* (2009), the U.S. Supreme Court ruled that the EPA was permitted to consider costs in comparison to benefits when determining the “best available technology” by which the national standards would be set.

**B.** The SWRCB’s policy allows for consideration of compliance costs in the possible granting of an exemption from Track I compliance for nuclear power plants.

## **2. It is certain that the costs of compliance with a requirement to install closed-cycle cooling towers will force PG&E to prematurely retire Diablo Canyon.**

Regardless of the particular technology and configuration chosen, the magnitude of the costs of closed-cycle cooling as estimated by Bechtel's report leaves no doubt that the CPUC will not allow PG&E to recover ratepayer funds on a multi-billion dollar investment in cooling towers at Diablo Canyon. Why should they? Cooling towers will significantly degrade the performance of the plant, and the money would be better spent purchasing other sources of energy. A combined-cycle natural gas plant of equivalent capacity could be built for as little as \$2.2 billion<sup>13</sup> and fueled for many years with the remaining money saved by not building cooling towers at Diablo Canyon. Of course, this would imply a huge setback to the state's GHG and other environmental goals, but such considerations were never seriously factored into the retirement of San Onofre: California's carbon price is far too low. The Board should dispense with the pretense that closed-cycled cooling is a real-world policy option on the table for consideration. The reality is that a requirement for cooling towers is tantamount to forcing the premature retirement of Diablo Canyon.

For clarity, this should not be construed to imply that we agree with any suggestion that Diablo Canyon should be shut down. We hold that continued operation using OTC is the best course of action for the environment and PG&E ratepayers, but should the Board impose a closed-cycle cooling requirement on Diablo Canyon, the CPUC would be foolish to allow PG&E to spend the money.

## **3. The premature retirement of Diablo Canyon will cause far greater environmental impacts than its continued operation using once-through cooling. Additionally, its retirement will impose significant and unreasonable economic costs on PG&E ratepayers.**

Assuming an annual net generation of 17.6 TWh from Diablo Canyon, replacing it with a typical combined-cycle natural gas plant would entail CO<sub>2</sub> emissions on the order of 7.1 million metric tons per year.<sup>14</sup> Additionally, since the Board policy on new plants prohibits new OTC facilities, such a replacement plant would invariably consume some source of fresh water for condensation of the steam cycle. According to data from the California Energy Commission, the typical combined-cycle natural gas plant in California consumes 522.1 gallons of water per MWh generated.<sup>15</sup> This equates to an annual fresh water consumption of 9.2 billion gallons, or 28,200 acre-feet. While it seems plausible that some source of reclaimed water could be located for use by such a plant, any and all available reclaimed water would be put to much better use addressing the State's existing water shortage. It is wholly anathema to common sense that the body charged with ensuring the availability of water would take an action to further aggravate California's drought by creating new sources of demand. The increased consumption of water could be avoided with a single-cycle natural gas plant, but that would imply even more unacceptable increases in GHG emissions.

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<sup>13</sup> Assuming \$1/watt. Source: <http://www.eia.gov/forecasts/capitalcost/> Table 2.

<sup>14</sup> Assuming a heat rate of 7,615 btu/kWh ([http://www.eia.gov/electricity/annual/html/epa\\_08\\_02.html](http://www.eia.gov/electricity/annual/html/epa_08_02.html)) and a CO<sub>2</sub> emissions factor for natural gas of 53.1 kg per MMBTU ([http://www.eia.gov/environment/emissions/co2\\_vol\\_mass.cfm](http://www.eia.gov/environment/emissions/co2_vol_mass.cfm))

<sup>15</sup> Alvarado and Loyer. 2012. "Criteria Air Emissions and Water User Factors for Gas and Electricity Efficiency Savings for the 2013 Building Energy Efficiency Standards." Page 13. [http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/General/2013\\_Initial\\_Study\\_Air\\_and\\_Water\\_Emission\\_Factors.pdf](http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/General/2013_Initial_Study_Air_and_Water_Emission_Factors.pdf)

#### **4. The hypothesis that Diablo Canyon could be replaced with non-thermoelectric, renewable sources of energy such as solar PV or wind has been repeatedly falsified by the historical record of nuclear power plant retirements in California. Nuclear power provides reliable power and flexible siting that cannot be replicated, except by fossil fuels.**

##### ***Humboldt Bay Unit 3***

Humboldt County is a transmission-constrained area at the far reaches of PG&E's service territory. The nuclear unit (#3) of Humboldt Bay Power Plant ceased operations in 1976, while the co-sited fossil fuel units (#1 & 2) of Humboldt Bay Power Plant continued until 2010. They were replaced with the fossil fuel units of a new, nearby plant, the Humboldt Bay Generating Station. This was necessitated by the numerous limits to the availability, economics, feasibility of renewable resources. The productivity of solar panels is quite poor in this northern, foggy, coastal county compare to the rest of the state.<sup>16</sup> Offshore wind resource is technically good but too expensive to develop; there are some decent pockets of decent onshore wind.<sup>17</sup> There is no known geothermal potential.<sup>18</sup> Biomass is the primary renewable resource that is both technically available and (relatively) economically viable, but since it is primarily woody, it operates on the Rankine cycle, which necessitates the use of cooling water. PG&E states that continued use of fossil fuels at Humboldt Bay is necessary to integrate intermittent renewables<sup>19</sup>.

##### ***Rancho Seco***

The site of the decommissioned reactor at Rancho Seco currently hosts a 500 MW natural gas plant, as well as a paltry 2 MW solar farm. This is fairly representative of the direction of California's energy policy since the Legislature placed a moratorium on new nuclear power plant construction in 1976: more natural gas and token amounts of renewable energy.

##### ***San Onofre Unit 1***

When San Onofre Unit 1 was retired in 1992 after a protracted debate between the utility owners and the CPUC's Division of Ratepayer Advocates was resolved with a settlement, anti-nuclear activists rejoiced:

*"Lynn Harris Hicks, former advocate for GUARD, one of the first groups to oppose construction of SONGS 2 and 3... said the settlement was an exciting development and might spur Edison's development of solar technologies."*<sup>20</sup>

Despite their wishful thinking, the retirement of SONGS Unit 1 spurred absolutely no further development in solar technology. After reaching a measly record 856 MWh in 1993, California's annual solar electricity generation wobbled up and down around 800 MWh for the following seventeen years, until finally showing measureable growth in 2010.<sup>21</sup> San Onofre Unit 1 generated 51 TWh over its 24 year operating lifetime.<sup>22</sup> This is equivalent to twice the amount of solar electricity generated between 1983 (the earliest year for which CEC statistics are available) and 2013.

##### ***San Onofre Units 2 & 3***

Even still today, California's energy policies are not properly designed to consistently ensure that the loss of one source of low-carbon generation is always met by the construction of new low-carbon generation. The

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<sup>16</sup> [http://apps1.eere.energy.gov/states/images/maps/map\\_large\\_pv\\_CA.jpg](http://apps1.eere.energy.gov/states/images/maps/map_large_pv_CA.jpg)

<sup>17</sup> [http://apps2.eere.energy.gov/wind/windexchange/images/windmaps/ca\\_80m.jpg](http://apps2.eere.energy.gov/wind/windexchange/images/windmaps/ca_80m.jpg)

<sup>18</sup> [http://www.energy.ca.gov/maps/renewable/geothermal\\_areas.html](http://www.energy.ca.gov/maps/renewable/geothermal_areas.html)

<sup>19</sup> <http://www.pge.com/en/about/environment/pge/minimpact/humboltdbay/index.page>

<sup>20</sup> *California Energy Markets*, Issue No. 140, January 17<sup>th</sup>, 1992.

<sup>21</sup> [http://energyalmanac.ca.gov/electricity/electricity\\_generation.html](http://energyalmanac.ca.gov/electricity/electricity_generation.html)

<sup>22</sup> <http://www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=604>

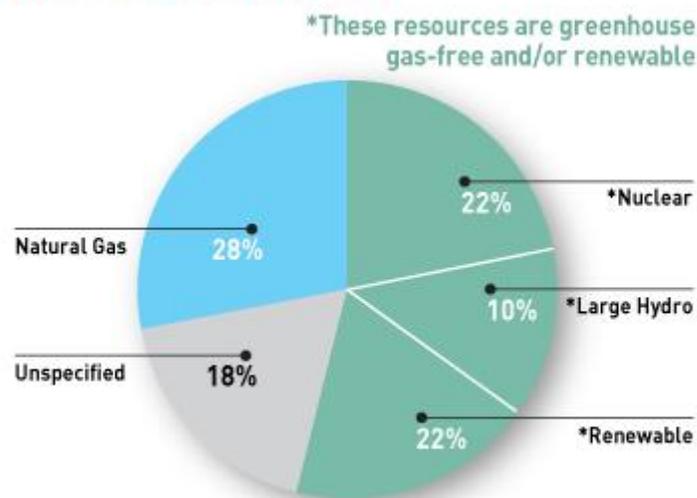
RPS deliberately excludes nuclear and large hydroelectric facilities. The result is that their value as zero-carbon generators is not factored into the decisions about maintenance and operating life extensions. When they retire, utilities incur no obligation to replace them with another source of zero-carbon generation or take other actions with equivalent reductions in carbon emissions. In theory, total emissions in California are capped by AB32 and the carbon market sends a price signal about the social cost of carbon. In reality, the cap set by CARB is far from binding — demand for permits collapsed due to the Recession — and the price of emissions permits is hovering very near to the regulated price floor.

Despite stated pledges by California’s energy agencies to replace SONGS with at least “50% preferred resources” (i.e. energy efficiency and renewable energy), these half-hearted statements so far have done nothing to mitigate California’s increased GHG emissions recorded in 2012, for which the state was thoroughly mocked on National Public Radio last December.<sup>23</sup> Recently the Energy Commission has approved two repowered natural gas plants, one in Carlsbad<sup>24</sup> and the other in Huntington Beach,<sup>25</sup> both of which are expressly needed to supply reliable, local generation to compensate for the loss of voltage support provided to the Southern California grid by SONGS. These attributes cannot be matched by renewable energy, as solar PV and wind energy are not sufficiently reliable, nor can wind, biomass, or geothermal be sited within the Los Angeles and San Diego basins.

**5. Recent developments in the cost and technical viability of renewable resources, while promising, should not be relied upon to replace a major zero-carbon generator at a time when PG&E’s power mix still remains largely dependent on natural gas and mostly fossil market purchases.**

New renewables will not offset the wedge left by the premature retirement of Diablo Canyon in California’s GHG emissions trajectory until many decades in the future, when PG&E’s generation mix approaches very a high level (78%) of zero-carbon resources. The retirement of Diablo Canyon in 2024, when PG&E will presumably reached an RPS level of 33%, will set back PG&E’s progress to a carbon-free power mix from 65% to 43%. This would be an enormous setback to the state’s GHG emission goals under AB32, just as the retirement of every nuclear power plant in California has been.

**PG&E 2013 POWER MIX**



**Note:** Power mix includes all PG&E-owned generation plus PG&E’s power purchases.

<sup>23</sup> <http://www.npr.org/2013/12/17/251781788/environmentalists-split-over-need-for-nuclear-power>

<sup>24</sup> <http://www.energy.ca.gov/sitingcases/carlsbad/>

<sup>25</sup> [http://www.energy.ca.gov/sitingcases/huntington\\_beach\\_energy/index.html](http://www.energy.ca.gov/sitingcases/huntington_beach_energy/index.html)

**Conclusion: As ratepayers and residents of California, we demand a serious cost-benefit analysis. We refuse to accept any regulation whose costs exceed its benefits.**

As this proceeding moves forward, we strongly urge the Board to adopt a finding of a need to modify the policy for nuclear-fuelled power plants, as laid out under 3.D.(7)-(9) of the Board's *Water Quality Control Policy on The Use Of Coastal And Estuarine Waters for Power Plant Cooling*.<sup>26</sup> We believe this action should be taken on account of (a) gratuitous and disproportionate compliance costs relative to the adverse environmental impact the regulation seeks to remedy, (b) highly contentious feasibility considerations, and (c) the even greater environmental impacts associated with the shutdown of Diablo Canyon and replacement by fossil fuels.

**Sincerely,**

**Andrew G. Benson,<sup>27</sup> on behalf of**

**Citizens for Green Nuclear Power, a local pro-nuclear organization based in San Luis Obispo County,**

**and other concerned residents of California:**

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<sup>26</sup> Page 12. [http://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/2013/061813\\_4\\_finalappdxa.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2013/061813_4_finalappdxa.pdf)

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## **Appendix A – Public Interest Energy Research (PIER) Reports on Cooling Technologies and Impacts**

The following studies are being provided here to ensure that they have all been entered into the public record and duly consider by the staff of the SWRCB. These are reports published by researchers who received funding from the Public Interest Energy Research Program (PIER) program, managed by the California Energy Commission. These reports relate to cooling water intake structures, their impacts, possible mitigation measures, and the tradeoffs inherent to different cooling technologies. Many of these reports have not been published until recently and may have not yet come to the attention of parties involved in this proceeding. This may not be a comprehensive list, as it was assembled from limited publicly available information.

<http://www.energy.ca.gov/reports/CEC-500-2004-092/CEC-500-2004-092.PDF>

<http://www.energy.ca.gov/2009publications/CEC-500-2009-055/CEC-500-2009-055.PDF>

<http://www.energy.ca.gov/2013publications/CEC-500-2013-049/CEC-500-2013-049.pdf>

<http://www.energy.ca.gov/2011publications/CEC-500-2011-008/CEC-500-2011-008.pdf>

<http://www.energy.ca.gov/2013publications/CEC-500-2013-053/CEC-500-2013-053.pdf>

<http://www.energy.ca.gov/2007publications/CEC-500-2007-120/CEC-500-2007-120.PDF>

<http://www.energy.ca.gov/2011publications/CEC-500-2011-020/CEC-500-2011-020.pdf>

<http://www.energy.ca.gov/2011publications/CEC-500-2011-020/CEC-500-2011-020.pdf>

<http://www.energy.ca.gov/2013publications/CEC-500-2013-072/CEC-500-2013-072.pdf>

<http://www.energy.ca.gov/2006publications/CEC-500-2006-034/CEC-500-2006-034.PDF>

<http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF>

<http://www.energy.ca.gov/2008publications/CEC-500-2008-043/CEC-500-2008-043.PDF>

<http://www.energy.ca.gov/2013publications/CEC-500-2013-065/CEC-500-2013-065.pdf>

<http://www.energy.ca.gov/2007publications/CEC-500-2007-124/CEC-500-2007-124.PDF>