BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans	Rulemaking 10-05-006 (Filed May 6, 2010)

REQUEST FOR AN AWARD OF COMPENSATION TO THE UNION OF CONCERNED SCIENTISTS FOR SUBSTANTIAL CONTRIBUTIONS TO DECISION (D.) 12-04-046

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Dated: June 22, 2012

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I. INTRODUCTION

In accordance with §1804(c) of the Public Utilities Code, the Union of Concerned Scientists ("UCS") submits this request for an award of intervenor compensation for its substantial contributions to Decision ("D." of "Decision") 12-04-046, *Decision on System Track I and Rules Track III of the Long-Term Procurement Plan Proceeding and Approving Settlement*, which approves a settlement for the 2010 LTPP system plan, and makes various determinations on Track III rules, including contracting with once-through cooling ("OTC") generation units, the procurement of electricity from utility-owned generation ("UOG") versus procurement from independent generators, and IOU procurement of greenhouse gas ("GHG") compliance products. This Decision is the culmination of not only work regarding long-term procurement planning ("LTPP") policies and practices in R.10-05-006, but also R.08-02-007. Work performed by Energy Division staff, their consultants, and stakeholders including UCS, provided the foundation that was necessary to develop the CPUC-required scenarios for the 2010 LTPP. The development of planning standards and assumptions for these scenarios occurred through several workshops, filings, "homework assignments" and working group meetings. Although R.08-02-007 was closed without a final ruling, through the issuance of the May 13, 2010 *Order Instituting Rulemaking* ("OIR") establishing R.10-05-006, the California Public Utilities Commission ("Commission") specified that "Contributions made during the pendency of R.08-02-007 to issues within the scope of this proceeding may be considered for compensation in this proceeding."[1] UCS is claiming hours from both R.10-05-006 and R.08-02-007 in this request.

UCS requests $33,994.25 for its contributions from 2008 to 2010 to the Commission deliberations regarding the 2008 and 2010 long-term procurement planning proceedings.

UCS timely filed a Notice of Intent to Claim Intervenor Compensation ("NOI") in R.08-02-007 on May 2, 2008. On July 9, 2010, UCS submitted a NOI in R.10-05-006 and requested that its eligibility for compensation in R.08-02-007 be continued into the present proceeding. On September 14, 2006, an ALJ ruling was issued in R.06-02-012 that found UCS eligible to receive intervenor compensation, and also found UCS to be a "Category 3" customer meeting the standard of significant financial hardship within the meaning and definition of Public Utilities ("P.U.") Code Sections 1802(b)(1)(C) and 1802(g). UCS's circumstances with respect to eligibility have not changed.

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[1] OIR, p.27.

In accordance with P.U. Code §1804(c), this request is being filed within 60 days of the mailing date of D.12-04-046, the most recent decision in R.10-05-006. This request includes a description of UCS's substantial contributions to D.12-04-046, as well as a detailed description of services. UCS has previously been awarded intervenor compensation in D.96-08-040, D.98-01-007, D.03-10-085, D.04-03-033, D.05-06-025, D.06-04-022, D.07-06-032, D.07-05-028, D.08-12-017, D.10-04-022, and D.11-07-022. As requested by the Commission in D.04-03-033, UCS attests that no grant monies from any source were used to fund work for which UCS is requesting intervenor compensation.

II. UCS MADE SUBSTANTIAL CONTRIBUTIONS TO D.12-04-046

A. Standards for Finding of Substantial Contribution

UCS's participation in R.08-02-007 and R.10-05-006 have clearly met the requirements for establishing a substantial contribution, as defined in Sections 1802(i) and 1803 of the Public Utilities Code. Section 1802(i) states:

> 'Substantial contribution' means that, in the judgment of the commission, the customer's presentation has substantially assisted the commission in the making of its order or decision because the order or decision has adopted in whole or in part one or more factual contentions, legal contentions, or specific policy or procedural recommendations presented by the customer. Where the customer's participation has resulted in a substantial contribution, even if the decision adopts that customer's contention or recommendations only in part, the commission may award the customer compensation for all reasonable advocate's fees, reasonable expert fees and other reasonable costs incurred by the customer in preparing or presenting that contention or recommendation.

Section 1803 states in part:

> The commission shall award reasonable advocate's fees, reasonable expert witness fees, and other reasonable costs of preparation for and participation in a hearing or proceeding to any customer who…satisfies…the following requirements:
> (a) The customer's presentation makes a substantial contribution to the adoption, in whole or in part, of the commission's order or decision.

The Commission has elaborated on this statutory standard as follows:

> A party may make a substantial contribution to a decision in various ways. It may offer a factual or legal contention upon which the Commission relied in making a decision. Or it may advance a specific policy or procedural recommendation that the ALJ or

> Commission adopted. A substantial contribution includes evidence or argument that supports part of the decision, even if the Commission does not adopt a party's position in total. The Commission has provided compensation even when the position advanced by the intervenor is rejected. (D.99-08-006)

With respect to the last sentence in the quoted section immediately above, the Commission has made clear that a substantial contribution may consist of "…provid[ing] a unique perspective that enriched the Commission's deliberations and the record…"[2] even if the position advanced is not adopted.

B. UCS's Substantial Contributions in D.12-04-046

This Decision approves a settlement for the 2010 LTPP system plan, and makes various determinations on Track III rules. UCS is requesting compensation for the substantial amount of work that went into developing the methodology, inputs, and assumptions for the four CPUC-required scenarios that provided the foundation for the 2010 system plan settlement agreement that is adopted in this Decision. This would not have been possible had it not been for the large amount of analytical work in R.08-02-007 that formed the assumptions for the scenarios addressed in the 2010 LTPP.

In R.08-02-007, one of the first issues the Commission addressed was how future LTPP standards and practices should evaluate the uncertain costs of different portfolios in the face of GHG regulations at the state level (under AB 32) or the federal level. UCS was an active participant[3] in the Commission's greenhouse gas proceeding, R.06-04-009, and applied its experience by submitting pre-workshop comments jointly with the Natural Resources Defense Council ("NRDC") and participating in the July 10, 2008 workshop.

Specifically, UCS assisted the Commission in developing a record for and otherwise informing the foundation for the 2010 LTPP system plan settlement, approved in D.12-04-046 in the following ways:

1. UCS advocated for scenario modeling that accounted for the indirect effect of carbon prices on other variables, such as the price of natural gas, demand, retirement of fossil fuel plants, and the hedging value of long-term renewable energy contracts.[4]

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[2] D. 07-06-032 at 4.
[3] UCS was awarded intervenor compensation for substantial contributions in R.06-04-009 on April 8, 2010 in D.10-04-022
[4] UCS/NRDC Pre-Workshop Comments on GHG Uncertainty, filed June 30, 2008, pp. 7-10.

2. UCS urged the Commission to consider "high," "medium," and "low" carbon price scenarios and suggested specific literature to guide the assumptions on various carbon prices.[5]

3. UCS urged the Commission to model various scenarios beyond the 10-year LTPP planning period to understand how portfolio choices in the next 10 years would impact achieving the state's long-term GHG reduction goals under AB 32, which extend to 2050.[6]

A second major focus in R.08-02-007, of which UCS was heavily involved, was the development of assumptions behind, and the refinement of, a 33 percent RPS Implementation Analysis. This analysis formed the basis of assumptions regarding how many renewable generation resources would be developed to meet the 33% RPS, where they would be developed, what it would cost to development them, and what infrastructure (i.e. transmission lines) would need to be upgraded or construction to support them. The 33% RPS Implementation Analysis also formed the foundation for the RPS integration model developed by the California Independent System Operator ("CAISO") and significantly impacted the overall procurement analysis undertaken in the 2010 LTPP. In order to provide the level of technical feedback necessary to participate in the Energy Division's 33% RPS Integration Analysis Working Group ("IAWG"), UCS hired Dr. Matthias Fripp, a renewable energy expert who developed *Switch*, the first large-scale power system planning model with enough hour-by-hour and project-by-project detail to identify least-cost strategies for regions with large shares of intermittent power and co-optimize investments in wind, solar and conventional generation capacity and transmission. Dr. Fripp worked closely with UCS Senior Energy Analyst Laura Wisland to prepare responses to a data request prior to the August 26, 2008 33% RPS Implementation Analysis workshop. Both Fripp and Wisland provided the Energy Division with feedback at the workshop. At the request of Energy Division staffer Simon Baker, Fripp prepared a technical memo on renewable energy technology cost trends and projections that contained substantial information on technology costs over time and references for more information on the issues. Finally, Fripp and Wisland prepared

[5] *Ibid.*, pp.3-7.
[6] *Ibid.*, pp.10-17.

extensive and technical comments in response to the Preliminary 33% RPS Implementation Analysis.

Specifically, UCS assisted the Commission in developing a record for and otherwise informing the foundation for the 2010 LTPP system plan settlement, approved in D.12-04-046 in the following ways:

1. UCS provided information on the level of granularity required to understand the system needs to integrate a 33 percent RPS and how the data could be collected.[7]

2. UCS highlighted some caveats to using a "supply curve" approach to estimate the amount of renewables needed to reach the 33% RPS and what other approaches the Commission might want to consider in order to better reflect the dynamic nature of the current power system.[8]

3. UCS offered suggestions for how the Commission could account for "beyond 2020" policy issues, especially the likelihood of significant technology improvement and cost reduction over time, particularly for solar PV technologies and the role that energy storage could play in integrating large amounts of intermittent generation resources.[9]

4. As a follow-up to UCS's comments on the need for at least one RPS scenario to assume renewable energy technology improvement and cost reductions over time, UCS was asked by Simon Baker, who was leading the LTPP proceeding for Energy Division at the time, to develop a memo that contained more detail on what types of assumptions the Commission could use to reflect technology cost declines over time. The memo also contained a robust set of literature that supported such assumptions.[10] Since this memo was not filed with the Commission, UCS has included a copy of it in Appendix C of this request.

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[7] UCS Pre-Workshop Comments on the Methodology, Scope, and Stakeholder Process for the 33% RPS Implementation Analysis, filed August 15, 2008, pp.5-7
[8] *Ibid.*, pp.3-4
[9] *Ibid.* pp.7-8
[10] UCS Renewable Technology Cost Trends and Projections Memo, submitted to Simon Baker on November 24, 2008.

5. UCS also provided technical comments following a December 16, 2008 IAWG meeting regarding its concern that solar cost estimates proposed for the 33% RPS Implementation Analysis were too high because they did not assume price declines over time. These comments also stressed the importance of optimizing transmission to renewable energy zones that are comprised of resources with complementary generation profiles, to reduce the amount of transmission that would need to be constructed to meet the 33% RPS.[11]

6. UCS provided extensive technical feedback on the 33% Preliminary RPS Implementation Analysis, which was released on June 12, 2009. This feedback included 16 pages of general comments on the RPS Calculator, which was submitted to the Energy Division on August 26, and responses to technical questions posed to the IAWG and TCWG, which were submitted on August 28th. UCS's comments centered around the various ways UCS believed the RPS calculator overestimated the costs of reaching the 33% RPS, including attributing the entire cost of building new transmission lines to the 33% RPS, assuming no transmission could be built to out of state renewable energy zones, excluding non-California wind resources, and failing to assume any technology cost declines over time.[12]

A third area of focus within R.08-02-007 that involved UCS was the development of standardized resource planning practices, assumptions and analytic techniques that could be applied in future long-term procurement plans, beginning with the 2010 LTPP. UCS actively participated in this effort, by submitting pre-workshop comments jointly with NRDC that preceded an August 28, 2008 workshop, participating in the workshop, participating in the LTPP Planning Scenarios and Metrics Working Group and responding to several Energy Division data requests, and responding to the LTPP Planning Standards staff proposal.

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[11] UCS Comments on the December 16, 2008 Presentation to the 33% RPS Implementation Analysis Working Group, submitted Jan. 6, 2009, pp.1-2.

[12] UCS Comments on Energy Division's 33% RPS Implementation Analysis Preliminary Report, submitted August 26, 2009, pp.3-16; and UCS responses to technical questions for 33% RPS Implementation Working Group and Transmission Constrained Working Group, submitted August 28, 2009, pp.1-3.

Specifically, UCS assisted the Commission in developing a record for and otherwise informing the foundation for the 2010 LTPP system plan settlement, approved in D.12-04-046, in the following ways:

1. In its pre-workshop comments on planning scenarios and metrics, among other things, UCS provided feedback on the Commission's proposed Guiding Principles for LTPP scenario development, how to quantify risk in long-term portfolios, and how to approach environmental performance metrics across scenarios.[13]

2. Pre-workshop comments also contained specific input assumptions for the 2010 LTPP reference case scenario and a proposal for a "technology advancement and innovation" scenario that would contain more aggressive assumptions regarding technology performance improvements and technology cost declines than the reference case.[14]

3. In response to a data request following the August 28, 2008 Scenarios and Metrics workshop, UCS submitted comments regarding the analytic steps that the Commission and the IOUs should take after developing scenarios but before selecting a preferred portfolio, and the cost metrics that should be used to evaluate different portfolios. UCS stressed the importance of expressing costs as impacts to average electricity bills (not rates) to reflect the cost-savings potential of energy efficiency.[15]

4. UCS also provided comments on the Aspen/E3 report that surveyed utility resource planning and procurement practices for application to the 2010 LTPP that emphasized the importance of measuring the GHG emission reduction potential of each planning scenario, and "homework" responding to Energy Division questions regarding how environmental issues should be addressed in the LTPP. Here, UCS cautioned against a detailed environmental screening or ranking process in the LTPP because detailed consideration of the environmental attributes of renewable energy projects is highly

[13] UCS/NRDC Pre-workshop Comments on Planning Scenarios and Metrics, filed August 22, 2008, pp.1-7.
[14] *Ibid.*, pp.9-15
[15] UCS/NRDC Comments in Response to the August 29, 2008 Energy Division Request Regarding LTPP Scenarios and Metrics, filed September 5, 2008, p.5.

specific and should be done during the actual permitting process. However, UCS did support the IOUs incorporating permitting considerations when building up renewables for various scenarios, to ensure the portfolios did not assume large quantities of renewable energy resources that would never get built for environmental reasons.[16]

5. In response to the Energy Division's LTPP Straw Proposal, released on July 1, 2009, UCS jointly filed comments with the Green Power Institute ("GPI") that emphasized the need to develop the 2010 LTPP in a way that achieves the state's GHG emission reduction goals. Specifically, the comments strongly supported the Energy Division's LTPP Straw proposal in lieu of the one proposed by Southern California Edison ("SCE") and San Diego Gas and Electric ("SDG&E") which attempted to limit the LTPP process to development of a bundled plan.[17]

6. The UCS/GPI joint comments on the LTPP Straw Proposal also identified several limitations to relying exclusively on the Commission's Preliminary 33% RPS Implementation Analysis and the results of the Renewable Energy Transmission Initiative ("RETI"), which provide conceptual frameworks for renewable energy planning, but should not be considered roadmaps for "optimal" renewable energy development to meet the 33% RPS.[18]

7. Finally, the UCS/GPI comments proposed including a "market transformation" scenario that assumed declining technology costs over time, and included a list of academic literature references that provided supporting material on the declining costs of solar resources in an appendix to its comments.[19]

8. UCS also submitted reply comments on the LTPP Straw Proposal that provided further evidence for rejecting the SCE/SDG&E alternative proposal, supported the

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[16] UCS/NRDC Comments on the Aspen/E3 Draft "Survey of Utility Resource Planning and Procurement Practices for Application to Long-Term Procurement Planning in California," filed October 1, 2008, pp.1-2; and UCS/NRDC "Homework" Response Comments in Response to Energy Division Request Regarding LTPP Environmental Issues, pp.1-4.
[17] UCS/GPI Comments on the Energy Division Straw Proposal for LTPP Standards, filed August 21, 2009, pp.2-3.
[18] *Ibid.*, pp.6-9.
[19] *Ibid.*, pp.12-13.

inclusion of a "transmission constrained scenario" in the 2010 LTPP system plan, and provided additional support for quantifying GHG emissions reductions on both the system and bundled plans.[20]

On May 13, 2010, R.08-02-007 was subsumed by R.10-05-006. UCS participated in the first major activity in R.10-05-006, which was to develop the planning standards for the 2010 system plans. UCS coordinated its participation with NRDC, and focused on planning assumptions related to renewables and energy efficiency.

Specifically, UCS assisted the Commission in developing a record for and otherwise informing the foundation for the 2010 LTPP system plan settlement, approved in D.12-04-046, in the following ways:

1. UCS submitted comments on the need to assume a 33% RPS by 2020 in the base case, assume renewable energy cost declines over time, and include at least one scenario that assumed the deployment of energy storage technologies.[21]

2. These comments also emphasized the importance of performing sensitivity analyses that changed the dispatch of resource portfolios and the need to include energy efficiency savings in the reference case assumptions.[22]

3. On July 9, 2010, UCS and NRDC responded to six questions posed by the Energy Division regarding renewable resource planning standards for the 2010 system plans. The comments pointed out the unusually high capital costs assumed for geothermal resources, and the high operation and maintenance costs for wind. In addition, the comments questioned why E3 had not assumed any fixed operation and maintenance costs for geothermal, and once again pointed out the limitations of assuming no technology cost declines over time.[23] These comments also emphasized a concern that

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[20] UCS/GPI Reply Comments on the Energy Division Straw Proposal for LTPP Standards, filed August 31, 2009.
[21] UCS/NRDC Comments on Resource Planning Assumptions- Part 1, Procurement Planning Assumptions and Rulebook, filed June 21, 2010, pp.4-5.
[22] *Ibid.*, pp.6-7.
[23] UCS/NRDC Comments on Resource Planning Assumptions- Part 2, Long-term Renewable Resource Planning Standards, filed July 9, 2010, pp.2-3.

transmission upgrade and construction costs were being exclusively attributed to the 33% RPS when in reality, many of these upgrades would be necessary without additional renewable energy development. Finally, the comments urged the Commission to assume some level of energy storage technology deployment to understand how energy storage could play a role integrating renewables without generating additional fossil fuel emissions through the combustion of natural gas.[24]

4. UCS also filed reply comments on the 2010 LTPP renewable resource planning standards that provided additional feedback to the Energy Division on how the "discounted core" should be developed for all scenarios, and the importance of exploring whether some coal plant retirements in the Western Electricity Coordinating Council ("WECC") should be assumed based on EPA analyses at the time.[25]

III. UCS'S PARTICIPATION HAS BEEN EFFICIENT AND PRODUCTIVE

In conducting its work, UCS consistently coordinated its efforts in this proceeding with other parties as much as possible to avoid duplication of effort and to ensure efficiency. Any duplication that occurred in this proceeding was unavoidable due to parties' sometimes similar interests, and the overwhelming number and scope of issues addressed in the decision. In an effort to minimize duplication, UCS coordinated with NRDC and GPI over the course of the proceedings. UCS applied its in-house and consultant technical expertise in renewable energy issues and provided unique analysis as noted above in the detail of its contributions to the Decision.

In D.98-04-059, the Commission adopted a requirement that a customer must demonstrate that its participation was "productive," as that term is used in §1801.3. The Commission directed customers to demonstrate productivity by attempting to assign a reasonable dollar value to the benefits of their participation to ratepayers. UCS requests that the Commission treat this compensation request as it has treated similar past requests with regard to

[24] *Ibid.*, pp.5-7.
[25] UCS Reply Comments on Resource Planning Assumptions- Part 2, Long-term Renewable Resource Planning Standards, filed July 16, 2010.

the difficulty of establishing specific monetary benefits associated with the participation of consumer and environmental intervenors.

In a policy proceeding such as this one, particularly one concerned as much with environmental benefits as economic benefits, it is extremely difficult to estimate the monetary benefits of UCS's participation. However, UCS submits that its contributions to developing long-term procurement planning standards to adequately plan for long-range GHG emission reduction goals, and developing specific assumptions to understand the implications of increasing the amount of renewable energy generation on the electricity grid, will benefit ratepayers. In D.07-12-052 (concerning the 2006 LTPP) the Commission found that "An overarching problem in all the IOU's plans is the absence of any scenario analysis regarding the types of resources the IOUs should use to fill their net short positions to best transition to the forthcoming GHG-constrained world."[26] UCS's participation in R.08-02-007 and R.10-05-006 from 2008 through 2010 to improve the development of the LTPP process was based on the believe that an open, rigorous and systematic long-range planning process is crucial to transitioning California's reliance away from fossil fuels and toward energy efficiency and renewables, in order to meet the state's 2050 emission reduction goals. UCS did not continue its work on the LTPP into 2011 and participate in the settlement agreement process because of resource constraints and its general support for the foundation of assumptions that were behind the 2010 system plan settlement.

In conclusion, UCS's work materially assisted the Commission in developing the planning standards and renewable energy assumptions that will be used and expanded for future LTPP processes. UCS submits that its work in this case therefore can be expected to save ratepayers many times the cost of our participation. As such, the Commission should find that the costs of UCS's participation bear a reasonable relationship to the magnitude of UCS's contributions, and that UCS's overall participation was productive.

IV. UCS'S CLAIM IS REASONABLE

The hours and expenses claimed by UCS are reasonable and properly detailed, and the hourly rates requested are reasonable and consistent with rates requested by other intervenors for

[26] D.07-12-052, available at http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/76979.htm

staff of similar experience and expertise, as well as with rates paid by IOUs to their staff and to outside consultants with similar experience and expertise.

A. The Hours Claimed Are Reasonable and Properly Detailed

UCS has maintained detailed records of time spent on these proceedings, which are provided in Appendix B. UCS is seeking compensation for time spent by staff and outside consultants. The hours claimed are reasonable given the scope of this proceeding and the complexity of the issues presented. No compensation for administrative time or local travel time is requested, in accordance with Commission practice.

The individuals who worked on this phase of the proceeding and for whom UCS is requesting compensation are current UCS staff member Laura Wisland, and consultants Matthias Fripp and Clyde Murley. A summary of the hours, requested rates, and amount of request by individual is provided below:

Proceeding Preparation and Participation

Laura Wisland, Senior Energy Analyst, Union of Concerned Scientists

2008 Hrs	2008 Rate	2009 Hrs	2009 Rate	2010 Hrs	2010 Rate	
71	$125	44.8	$130	19.65	$135	**Subtotal $17,351.75**

Matthias Fripp, Consultant

2008 Hrs	2008 Rate	2009 Hrs	2009 Rate	
42.75	$125	69	$125	**Subtotal $13,968.75**

Clyde Murley, Consultant

2009 Hrs	2009 Rate	
9.75	$205	**Subtotal $1,998.75**

Intervenor Compensation Request Preparation		
Laura Wisland, Senior Energy Analyst, Union of Concerned Scientists		
2012 Hrs	**2012 Rate**	
10	$67.50	**Subtotal $675.00**

Grand Total: $33,994.25

B. The Hourly Rates Claimed Are Reasonable

This section provides justification for the hourly rates requested for UCS staff and its consultants. The rates requested are consistent with rates awarded to other intervenors with commensurate experience and expertise performing similar tasks, and with D.08-04-010, which concerned the setting of 2006-2008 intervenor representatives' hourly rates. They are also consistent with rates adopted and/or adjusted for UCS staff and consultants in D.10-04-022

Laura Wisland. In D.11-07-022, the Commission approved a rate of $125 for work performed by Ms. Wisland in 2008, $130 for work in 2009, and $135 for work in 2010. UCS requests these rates for work performed in this proceeding as well.

Ms. Wisland is a Senior Energy Analyst in the Clean Energy Program at UCS, a position she assumed in 2008. Ms. Wisland has an M.P.P from the Goldman School of Public Policy at the University of California at Berkeley, and a Bachelor's degree in Environmental Public Policy from the University of North Carolina at Chapel Hill. Prior to joining UCS, Ms. Wisland worked as a demand response analyst for Pacific Gas and Electric Company and served as an energy intern with the California Public Utilities Commission, where she worked on rules to develop a tradable renewable energy credit market for the California RPS. Ms. Wisland also served as the Director of the California Hydropower Reform Coalition from 2004-2006. During the proceeding, Ms. Wisland prepared UCS's comments, participated in meetings with

Commission staff, intervenors and other stakeholders, participated in a workshops and prepared UCS's request for intervenor compensation.

Matthias Fripp. Dr. Fripp is a professor of electrical engineering at the University of Hawaii at Manoa, with 15 years of experience at the cutting edge of renewable energy and climate policy research. He specializes in modeling the technical and economic behavior of large-scale power systems with large shares of renewable energy. His experience includes undergraduate, graduate and post-doctoral research in this area, as well as work for non-profit and consulting firms. His work has focused in particular on the economic and technical limits to adoption of renewable power in California. As part of this work, he developed *Switch*, the first large-scale power system planning model with enough hour-by-hour and project-by-project detail to identify least-cost strategies for regions with large shares of intermittent power, co-optimizing investments in wind, solar and conventional generation capacity and transmission. This open-source model has also been extended to model renewable power deployment throughout the Western Electricity Coordinating Council region. Dr. Fripp has also developed groundbreaking expertise in the short-term variation of wind power on small and large geographic scales, and the spinning reserves needed to maintain generation adequacy. He has presented his research by invitation at the California Air Resources Board, California Public Utilities Commission and utility industry technical workshops. Dr. Fripp was a post-doctoral research fellow at the University of Oxford in 2008-2012. Prior to that he obtained a Ph.D. and M.S. from the Energy and Resources Group at the University of California, Berkeley, and a B.A. from Lewis & Clark College. During the proceeding, Dr. Fripp helped UCS analyze and propose modeling methods, data requirements, data sources and scenarios for the 33% RPS cost study.

UCS requests a rate of $125 for work performed in 2008 and 2009, which is well below the Commission's adopted rates in 2011 for individuals with 13+ years of experience in the field. Since this is the first time UCS is requesting compensation for Dr. Fripp's hours, his CV is attached.

Clyde Murley. Mr. Murley is an independent consultant with more than 20 years of professional experience in energy and environmental issues, including policy and technical experience and expertise in the areas of energy efficiency, renewable energy, demand response, integrated resource planning, energy economics, energy procurement, and environmental protection, and he has served as an expert witness in several of these areas. Mr. Murley represents clients both as a subject-matter expert and as an advocate in evidentiary and settlement proceedings. Mr. Murley's experience includes four-plus years with Grueneich Resource Advocates, where he represented clients before this Commission; three-plus years on the staff of the CPUC, where he managed environmental studies and advised the Commission on integrated resource planning and energy efficiency matters; three-plus years with the Natural Resources Defense Council, and four years during which he founded, directed, and taught in a graduate environmental studies program at Antioch University. Mr. Murley has also worked for PG&E as a research manager and has held various energy and environmental consulting positions. Mr. Murley holds two degrees from the University of California, Berkeley, a B.A. in Environmental Sciences, and a M.A. in Energy and Resources. During this proceeding, Mr. Murley assisted UCS in preparing analysis on the Market Price Referent, specifically analyzing and evaluating a gas price methodology. He also developed and delivered workshop presentations on this issue.

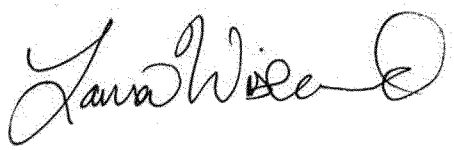
UCS requests a rate of $205 for work performed in 2008 and 2009, which is a rate the CPUC approved for Clyde Murley's work as a UCS intervenor in D.11-07-022.

V. CONCLUSION

UCS made significant contributions to Decision 12-04-046 in the ways described above. The hourly rates and costs claimed are reasonable and consistent with awards to other intervenors and utility experts and advocates with comparable experience and expertise, and consistent with the Commission's decisions regarding hourly rates. UCS has met the procedural requirements for intervenor compensation set forth in §1801 *et seq* of the Public Utilities Code. The Commission should grant UCS's claim in its entirety.

Respectfully submitted,

By



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Dated: June 22, 2012

APPENDIX A - LIST OF UCS FILINGS RELEVANT TO D.12-04-046

Date	Title
June 30, 2008	"Pre-Workshop Comments of the Natural Resources Defense Council and the Union of Concerned Scientists on Greenhouse Gas (GHG) Uncertainty"
August 15, 2008	"Pre-Workshop Comments of the Natural Resources Defense Council and the Union of Concerned Scientists on the Methodology, Scope, and Stakeholder Process for the 33% RPS Implementation Analysis"
August 22, 2008	"Pre-Workshop Comments of the Natural Resources Defense Council and the Union of Concerned Scientists on Planning Scenarios and Metrics"
September 5, 2008	"Comments of the Natural Resources Defense Council and the Union of Concerned Scientists in Response to the August 29, 2008 Energy Division Request Regarding LTPP Scenarios and Metrics"
October 1, 2008	"Comments of the Natural Resources Defense Council and the Union of Concerned Scientists on the Aspen/E3 Draft 'Survey of Utility Resource Planning and Procurement Practices for Application to LTPP in California'"
October 3, 2008	"'Homework' Response Comments of the Natural Resources Defense Council and the Union of Concerned Scientists in Response to the Energy Division Request Regarding Environmental Issues"
November 24, 2008	"Memo to Simon Baker, CPUC Energy Division: Renewable Energy Cost Trends and Projections"
August 21, 2009	"Comments of the Union of Concerned Scientists and the Green Power Institute on the Energy Division Straw Proposal for LTPP Standards"
August 26, 2009	"UCS Comments on Energy Division's 33% RPS Implementation Analysis Preliminary Report"
August 28, 2009	"UCS Responses to Technical Questions for 33% RPS Implementation Working Group and Transmission Constrained Working Group"
August 31, 2009	"Reply Comments of the Union of Concerned Scientists and the Green Power Institute on the Energy Division Straw Proposal for LTPP Standards"
June 21, 2010	"Comments of the Natural Resources Defense Council and the Union of Concerned Scientists on Resource Planning Assumptions – Part 1, Procurement Planning Assumptions and Rulebook"
July 9, 2010	"Comments of the Natural Resources Defense Council and the Union of Concerned Scientists on Resource Planning Assumptions – Part 2, Long-Term Renewable Resource Planning Standards"
July 16, 2010	"Reply Comments of the Union of Concerned Scientists on Resource Planning Assumptions – Part 2, Long-Term Renewable Resource Planning Standards"

APPENDIX B

UCS STAFF AND CONSULTANT TIME RECORDS FOR D.12-04-046

Appendix B: UCS Staff and Consultant Time Records for D.12-04-046

Name	Date	Length (hr)	Rate	Amount	Proceeding	Activity Code	Decision	Task
M.Fripp	8/8/08	1	$125	$125.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Reviewed Energy Division data request/request for pre-workshop comments for 33% RPS Implementation Analysis workshop
M.Fripp	8/10/08	1	$125	$125.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Discussed potential UCS response on data request/pre-workshop comments for 33% RPS Implementation Analysis 8/26/08 workshop with L.Wisland (UCS)
M.Fripp	8/10/08	3	$125	$375.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared portion of UCS response to data request/pre-workshop comments for 33% RPS Implementation Analysis 8/26/08 workshop (Compared resources and areas covered by IAP and RETI with CEC's database of planned projects and projections of need for renewables, to find sites that should be added for CPUC study)
M.Fripp	8/10/08	1.25	$125	$156.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared portion of UCS response to data request/pre-workshop comments for 33% RPS Implementation Analysis 8/26/08 workshop (tested whether average power production in 12-6 pm time frame adequately reflects correlation between renewables and load)
M.Fripp	8/12/08	1.5	$125	$187.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Met with L.Wisland (UCS) about wind/solar modeling techniques and problems with CPUC supply curve approach, to prepare for UCS response to data request for pre-workshop comments for 33% RPS Implementation Analysis workshop
M.Fripp	8/13/08	1.25	$125	$156.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS response on data request/pre-workshop comments for 33% RPS Implementation Analysis 8/26/08
M.Fripp	8/18/08	2.5	$125	$312.50	R.08-02-007	2010 LTPP Planning Scenarios and Metrics	D.12-04-046	Reviewed Energy Division data request/request for pre-workshop comments on LTPP Planning Scenarios and Metrics; discussed UCS/NRDC pre-workshop comments with L.Wisland (UCS)
M.Fripp	8/20/08	1.5	$125	$187.50	R.08-02-007	2010 LTPP Planning Scenarios and Metrics	D.12-04-046	Prepared risk analysis section of UCS/NRDC pre-workshop comments for 8/28/08 LTPP Planning Scenarios and Metrics workshop
M.Fripp	8/25/08	1.5	$125	$187.50	R.08-02-007	2010 LTPP Planning Scenarios and Metrics	D.12-04-046	Reviewed ACR and Scoping Memo for LTPP Planning Scenarios and Metrics and 33% RPS Implementation Analysis; considered effective ways to understand GHG cost risk
M.Fripp	8/25/08	1	$125	$125.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Discussed UCS positions with C.Chen and L.Wisland (UCS) to prepare for 8/26/08 RPS Implementation workshop
M.Fripp	8/26/08	1	$125	$125.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Reviewed CAISO renewable integration high level program plan, to see how it overlaps and differs from CPUC 33% RPS Implementation Analysis
M.Fripp	8/26/08	6	$125	$750.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Attended CPUC workshop on 33% RPS Implementation Analysis

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M.Fripp	11/14/08	3.5	$125	$437.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Discussed preparation of UCS Renewable Energy Cost Projection Memo: review outline from C.Chen (UCS), discussed data sources and main points; prepared UCS Renewable Energy Cost Projection Memo "UCS Cost Memo"
M.Fripp	11/19/08	1	$125	$125.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS Cost Memo
M.Fripp	11/20/08	5.5	$125	$687.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS Cost Memo
M.Fripp	11/21/08	8.5	$125	$1,062.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS Cost Memo
M.Fripp	12/15/08	0.5	$125	$62.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Review and responded to SCE comments on UCS Cost Memo to C.Chen (UCS)
M.Fripp	12/19/08	1.25	$125	$156.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Review ppt from 12/16/08 IAWG meeting and prepare comments in response; analyze capacity value of renewable projects from dissertation research to respond to E3 reducing capacity cost of CT plants based on their inframarginal energy savings and size/dispersion/risk of new transmission lines)
M.Fripp	6/13/09	2	$125	$250.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Read CPUC's Preliminary 33% RPS Implementation Analysis; prepared UCS comments
M.Fripp	8/8/09	2.75	$125	$343.75	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Reviewed CPUC/E3 white paper on Resource Ranking & Selection Methodology
M.Fripp	8/8/09	2.5	$125	$312.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Read CPUC/E3 whitepaper on Resource Ranking & Selection Methodoogy
M.Fripp	8/9/09	5	$125	$625.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Reviewed E3 RPS Calculator and prepared UCS response to Preliminary 33% RPS Implementation Analysis
M.Fripp	8/10/09	5.5	$125	$687.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Reviewed E3 RPS Calculator and prepared UCS response to Preliminary 33% RPS Implementation Analysis

Appendix B: UCS Staff and Consultant Time Records for D.12-04-046

M.Fripp	8/12/09	3.75	$125	$468.75	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Reviewed 33% RPS inputs and assumptions white paper.
M.Fripp	8/13/09	7.5	$125	$937.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis
M.Fripp	8/13/09	1.25	$125	$156.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Downloaded RPS Calculator to understand assumptions: used Switch model to check when Path 15 is likely to be filled by South-to-North transfers, to judge whether RPS Calculator's assumptions about Path 15 upgrade requirements are correct.
M.Fripp	8/19/09	2.75	$125	$343.75	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis
M.Fripp	8/20/09	5.75	$125	$718.75	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis
M.Fripp	8/21/09	6.25	$125	$781.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis
M.Fripp	8/22/09	1.5	$125	$187.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis
M.Fripp	8/23/09	3.5	$125	$437.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis discussed draft comments with L.Wisland
M.Fripp	8/24/09	5.25	$125	$656.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS comments on Preliminary 33% RPS Implementation Analysis
M.Fripp	8/26/09	5.5	$125	$687.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared Answers to CPUC Technical Questions for 33% RPS IAWG and TCWG (attached to UCS comments on Preliminary 33% RPS Implementation Analysis)
M.Fripp	8/27/09	6.25	$125	$781.25	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared Answers to CPUC Technical Questions for 33% RPS IAWG and TCWG (attached to UCS comments on Preliminary 33% RPS Implementation Analysis)
M.Fripp	8/28/09	1.5	$125	$187.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared Answers to CPUC Technical Questions for 33% RPS IAWG and TCWG (attached to UCS comments on Preliminary 33% RPS Implementation Analysis)
M.Fripp	9/1/09	0.5	$125	$62.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Review how MPR is currently used in IOU RPS RFPs, check which projects are affected by price-floor in RPS Calculator, consider effect of transmission costs on the ability of renewable projects to force prices up to MPR.
	Total 33% RPS Implementation Analysis					$13,281.25		
	Total 2010 LTPP Planning Scenarios and Metrics					$687.50		
	Matthias Fripp TOTAL					$13,968.75		

Appendix B: UCS Staff and Consultant Time Records for D.12-04-046

Name	Date	Length (hr)	Rate	Amount	Proceeding	Activity Code	Decision	Task
L.Wisland	6/19/08	4	$125	$500.00	R.08-02-007	GHG Uncertainty in LTPP	D.12-04-046	Prepare pre-workshop comments for GHG risk in LTTP proceeding
L.Wisland	6/25/08	4	$125	$500.00	R.08-02-007	GHG Uncertainty in LTPP	D.12-04-046	Prepare pre-workshop comments for GHG risk in LTTP proceeding
L.Wisland	7/7/08	2	$125	$250.00	R.08-02-007	GHG Uncertainty in LTPP	D.12-04-046	Summarize party pre-workshop comments for GHG risk
L.Wisland	7/10/08	6.5	$125	$812.50	R.08-02-007	GHG Uncertainty in LTPP	D.12-04-046	Attend LTTP workshop on GHG uncertainty
L.Wisland	8/12/08	1.5	$125	$187.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Met with M Fripp to prepare for UCS response to data request for pre-workshop comments for 33% RPS Implementation Analysis workshop
L.Wisland	8/15/08	4	$125	$500.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepared UCS response on data request/pre-workshop comments for 33% RPS Implementation Analysis 8/26/08
L.Wisland	8/18/08	2.5	$125	$312.50	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Reviewed Energy Division data request/request for pre-workshop comments on LTPP Planning Scenarios and Metrics; Discussed UCS/NRDC pre-workshop comments with M.Fripp
L.Wisland	8/18/08	1.25	$125	$156.25	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepared UCS/NRDC pre-workshop comments for 8/28/08 LTPP Planning Scenarios and Metrics workshop
L.Wisland	8/19/08	2	$125	$250.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepared UCS/NRDC pre-workshop comments for 8/28/08 LTPP Planning Scenarios and Metrics workshop
L.Wisland	8/22/08	6	$125	$750.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepared UCS/NRDC pre-workshop comments for 8/28/08 LTPP Planning Scenarios and Metrics workshop
L.Wisland	8/26/08	6	$125	$750.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Attended CPUC workshop on 33% RPS analysis
L.Wisland	8/28/08	6	$125	$750.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attended CPUC workshop on LTPP Planning Scenarios and Metrics
L.Wisland	9/2/08	1.25	$125	$156.25	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepared NRDC/UCS joint comments in response to 8/29 request for comments regarding LTPP Scenarios and Metrics
L.Wisland	9/9/08	3	$125	$375.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attended LTPP Scenarios and Metrics Working Group meeting

L.Wisland	9/12/08	3	$125	$375.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Read Aspen/E3 draft report "Survey of Utility Resource and Procurement Practices for Application to LTPP in CA"
L.Wisland	9/23/08	6	$125	$750.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attend CPUC LTPP Scenarios and Metrics Working Group meeting
L.Wisland	9/26/08	1.5	$125	$187.50	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Discuss 9/23 LTPP Scenarios and Metrics Working Group meeting and homework assignments with C.Chen (UCS) and P.Miller (NRDC)
L.Wisland	9/30/08	2.25	$125	$281.25	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare Joint UCS/NRDC comments on Aspen/E3 draft report "Survey of Utility Resource and Procurement Practices for Application to LTPP in CA"
L.Wisland	10/1/08	2.5	$125	$312.50	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare UCS/NRDC "homework" response comments to ED's request regarding LTPP environmental issues
L.Wisland	10/3/08	0.75	$125	$93.75	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare UCS/NRDC "homework" response comments to ED's request regarding LTPP environmental issues
L.Wisland	12/16/08	5	$125	$625.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Attend CPUC 33% RPS Implementation Analysis Working Group meeting
L.Wisland	1/8/09	1	$130	$130.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Participate in 33% implementation analysis conference cal re: Nexant study results
L.Wisland	1/15/09	5	$130	$650.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Attend CPUC 33% RPS Implementation Analysis Working Group meeting
L.Wisland	6/20/09	1	$130	$130.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Read Preliminary 33% RPS Implementation Analysis
L.Wisland	7/14/09	2	$130	$260.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Read Assigned Commissioner's Ruling and Scoping Memo on the 2010 Long-Term Procurement Proceeding, Phase I (aka staff proposal)
L.Wisland	8/6/09	5.5	$130	$715.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attend CPUC workshop on 2010 LTPP Planning Standards staff proposal
L.Wisland	8/7/09	3.5	$130	$455.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attend CPUC workshop on 2010 LTPP Planning Standards staff proposal
L.Wisland	8/10/09	1	$130	$130.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Discuss LTPP Planning Standards staff proposal workshop with G. Morris (GPI) and C.Murley (UCS)
L.Wisland	8/11/09	1	$130	$130.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Met with S. Baker (CPUC) to discuss LTPP Planning Standards staff proposal; accompanied by C.Murley (UCS)

L.Wisland	8/17/09	1.4	$130	$182.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare comments on 2010 LTPP Planning Standards staff proposal
L.Wisland	8/18/09	1.5	$130	$195.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare comments on 2010 LTPP Planning Standards staff proposal
L.Wisland	8/21/09	2.25	$130	$292.50	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare comments on 2010 LTPP Planning Standards staff proposal
L.Wisland	8/23/09	1	$130	$130.00	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Discussed draft UCS comments on Preliminary 33% RPS Implementation Analysis with M.Fripp
L.Wisland	8/24/09	1.25	$130	$162.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepare comments on Preliminary 33% RPS Implementation Analysis
L.Wisland	8/25/09	1.5	$130	$195.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare reply comments on 2010 LTPP Planning Standards staff proposal
L.Wisland	8/26/09	2.15	$130	$279.50	R.08-02-007	33% RPS Implementation Analysis	D.12-04-046	Prepare comments on Preliminary 33% RPS Implementation Analysis
L.Wisland	8/31/09	2	$130	$260.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare reply comments on 2010 LTPP Planning Standards staff proposal
L.Wisland	12/3/09	0.25	$130	$32.50	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Read ACR addressing future CPUC decisions related to procurement planning
L.Wisland	12/3/09	0.5	$130	$65.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Conversation with A. Chang (NRDC) about the ACR addressing future CPUC decisions related to procurement planning, and prepare for the Dec. 10 LTPP workshop
L.Wisland	12/10/09	6	$130	$780.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attended CPUC workshop on incorporating 33% RPS analysis into 2010 LTPP
L.Wisland	12/11/09	4	$130	$520.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Attended CPUC workshop on incorporating 33% RPS analysis into 2010 LTPP
L.Wisland	12/16/09	1	$130	$130.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Phone conversation with G.Morris (GPI) and A.Chang(NRDC) regarding incorporating 33% RPS analysis into 2010 LTPP
L.Wisland	5/28/10	1	$135	$135.00	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Read ALJ Ruling on 2010 LTPP Procurement Planning Standards
L.Wisland	6/15/10	0.5	$135	$67.50	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Phone call with D.Wang (NRDC) to discuss joint comments on 2010 LTPP Renewable Planning Standards

Appendix B: UCS Staff and Consultant Time Records for D.12-04-046

Name	Date	Length (hr)	Rate	Amount	Proceeding	Activity Code	Decision	Task
C.Murley	8/10/09	1	$205	$205.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Discuss LTPP Planning Standards staff proposal workshop with G. Morris (GPI) and L.Wisland (UCS)
C.Murley	8/11/09	1	$205	$205.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Met with S. Baker (CPUC) to discuss LTPP staff proposal; accompanied by L.Wisland (UCS)
C.Murley	8/17/09	2	$205	$410.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare comments on 2010 LTPP Planning Standards staff proposal
C.Murley	8/18/09	1.25	$205	$256.25	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare comments on 2010 LTPP Planning Standards staff proposal
C.Murley	8/26/09	3	$205	$615.00	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare reply comments on 2010 LTPP Planning Standards staff proposal
C.Murley	8/28/09	1.5	$205	$307.50	R.08-02-007	2010 LTPP Planning Standards	D.12-04-046	Prepare reply comments on 2010 LTPP Planning Standards staff proposal
				Total 2010 LTPP Planning Standards		**$1,998.75**		
					Total Clyde Murley	**$1,998.75**		

L.Wisland	6/18/10	6	$135	$810.00	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Attended CPUC workshop on renewables assumptions for 2010 LTPP
L.Wisland	6/21/10	2	$135	$270.00	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Prepared UCS/NRDC joint comments on Resource Planning Assumptions, Part 1 (assumptions for system plans and rulebook)
L.Wisland	6/23/10	1.75	$135	$236.25	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Read CPUC Long-Term Renewables Planning Standards and ALJ ruling on renewables planning standards
L.Wisland	7/8/10	2.25	$135	$303.75	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Prepare joint comments on 2010 LTPP Renewable Planning Standards
L.Wisland	7/12/10	3	$135	$405.00	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Read parties' comments on 2010 LTPP Renewable Planning Standards
L.Wisland	7/14/10	1	$135	$135.00	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Prepare reply comments on 2010 LTPP Renewable Planning Standards
L.Wisland	7/16/10	2.15	$135	$290.25	R.10-05-006	2010 LTPP Planning Standards	D.12-04-046	Prepare reply comments on 2010 LTPP Renewable Planning Standards
L.Wisland	6/19/12	5	$67.50	$337.50	R.10-05-006	Intervr Comp	D.12-04-046	Prepare UCS Intervenor Compensation Request
L.Wisland	6/20/12	4	$67.50	$270.00	R.10-05-006	Intervr Comp	D.12-04-046	Prepare UCS Intervenor Compensation Request
L.Wisland	6/22/12	1	$67.50	$67.50	R.10-05-006	Intervr Comp	D.12-04-046	Prepare UCS Intervenor Compensation Request
	Total GHG Uncertainty in LTPP					$2,062.50		
	Total 33% RPS Implementation Analysis					$3,544.50		
	Total 2010 LTPP Planning Standards					$11,744.75		
	Total Intervenor Compensation Preparation					$675.00		
	Laura Wisland TOTAL					$18,026.75		

R. 12-04-046 Compensation Request Summary

Union of Concerned Scientists Staff			
GHG Uncertainty	Laura Wisland		$2,062.50
33% RPS Implementation	Laura Wisland		$3,544.50
201 LTPP Planning Standards	Laura Wisland		$11,744.75
		TOTAL	**$17,351.75**
Consultant Matthias Fripp			
33% RPS Implementation	Matthias Fripp		$13,281.25
2010 LTPP Planning Standards	Matthias Fripp		$687.50
		TOTAL	**$13,968.75**
Consultant Clyde Murley			
2010 LTPP Planning Standards	Clyde Murley		$1,998.75
		TOTAL	**$1,998.75**
	TOTAL Expenses for D.12-04-046		**$33,319.25**
Union of Concerned Scientists Staff - Intevenor Compensation Preparation			
2012	Laura Wisland		$675.00
		TOTAL	**$675.00**
	TOTAL Intervenor Compensation Claim		**$675.00**
	TOTAL UCS CLAIM REQUEST		**$33,994.25**

APPENDIX C

Technical Memo to Simon Baker on Renewable Technology Cost Trends and Projections, November 24, 2008

Memorandum

To: Simon Baker, CPUC Energy Division

From: Matthias Fripp, Consultant to UCS
Cliff Chen, UCS

Date: November 24, 2008

Re: Renewable Technology Cost Trends and Projections

UCS prepared this memo concerning renewable technology cost trends and projections at the request of Energy Division staff, with the goal of informing the forthcoming Consultant's Straw Proposal on Planning Standards. We look forward to discussing these issues and collaborating with staff, E3, and interested parties to develop appropriate planning standards and assumptions for use in the LTPP proceeding.

1. The Rationale for Technology Learning

Wind turbines, solar photovoltaics and solar thermal electric systems are rapidly growing, knowledge-intensive technologies. As such, they can benefit from an ongoing process of "learning by doing," as experience gained in the development, manufacturing or installation of each generation of technology can then be used to reduce the costs of the next generation. Steady increases in size of plants or volume production also allow steady increases in economies of scale, further bringing down costs over time. The process of learning-by-doing is summed up by the well-known "learning curve" phenomenon, wherein productivity in a given industry or factory increases by a nearly constant percentage every time the cumulative experience in that process is doubled. Early studies of learning curves focused on individual factories (Argote and Epple 1990; Wright 1936), but recent studies have found that this phenomenon can apply across all manufacturers of a similar technology, such as solar photovoltaics or wind turbines (Neij et al. 2003; Nemet 2006). The most important implication of these learning curves is that as long as manufacturing experience continues to grow exponentially each year, the manufacturing cost can also be expected to drop by a fixed percentage each year. It should be noted that there may however be times when manufacturing costs continue to

fall but retail prices for these technologies do not (if demand temporarily outstrips supply), or when the cost of manufacturing declines but overall costs are held high by costs of material inputs.

2. Recent Market Conditions

While the prevailing historical trend suggests that costs of maturing renewable energy technologies will continue to decline in the future, the costs of some renewable energy generation facilities have increased in recent years. For instance, a recent LBL report suggests that after an extended period of historical cost reductions, average wind power capital costs have increased from $1,530/kW in 2006 to $1,670/kW in 2007. Based on data from proposed projects, the report estimates that wind capital costs will further increase to $1,870/kW in 2008 and $2,200/kW in 2009 (in $2007, Wiser and Bolinger 2008). However, there is evidence to suggest that these cost increases are largely due to short-term market factors. A 2008 presentation by one of the authors of the LBL report concludes that the largest driver of the recent wind capital cost increases is the weak dollar and its effect on inflating the prices of wind turbines imported from Europe and other countries (Bolinger 2008). This implies that costs could be reduced by the continued expansion of domestic wind turbine and component manufacturing capacity. The LBL presentation also identifies other less important factors, such as increases in materials, energy, and transportation costs and turbine manufacturing profitability, many of which could also prove to be of limited duration.

Similarly, solar PV prices have slightly increased and leveled out since 2004 after experiencing nearly three decades of steady cost reductions.[1] Evidence suggests that a global supply bottleneck in PV manufacturing facilities and the unprecedented surge in demand are largely responsible for the ahistorical PV pricing trends in the past three years (Pernick and Wilder 2008). Most market analysts expect that PV prices will be significantly lower in 2009 due to substantial increases to silicon feedstock supply and manufacturing capacity.

Due to the small number of projects installed, there is little or no corresponding evidence to suggest that CSP costs have increased in recent years. The limited data on

[1] http://www.solarbuzz.com/

existing projects notwithstanding, government and industry assessments consistently predict significant reductions to the costs of CSP projects in the near future (Stoddard et al. 2006, Charles et al. 2005).

The recent cost increase in wind generation projects is representative of the significant cost increases to the capital costs of all conventional electricity generation technologies since 2000.[2] While the recent increase in construction, materials, and labor costs for electric generating technologies is well-documented, there is considerable uncertainty about how long this trend will continue or whether costs will come back down and follow trends seen over the past few decades. This uncertainty is reflected in long-term cost projections from various electricity sector and technology experts. Some federal government agencies (e.g. EIA), academic institutions (e.g. MIT), and industry groups (e.g. EPRI) that are frequently used as references for power plant costs do not include the recent cost increases in either their short-term or long-term projections. For example, recent reports from EIA and MIT have assumed that the recent cost increases are the result of short-term supply constraints and that costs will likely revert back to long-term trends in the future. However, others sources, such as Black & Veatch and Standard and Poors, include the recent cost increases and assume that costs will remain at higher levels over time. At the same time, the economic downturn in 2008 appears to have substantially depressed commodity and energy prices, suggesting that electricity generation capital costs are unlikely to continue escalating.

All of this points to the tremendous uncertainty that exists over the future costs of all electricity generation projects. However, while the absolute values of future costs are highly uncertain, it remains highly likely that solar technology costs will decrease relative to conventional generation costs in the future as the market for the former continues to exponentially expand. This is the dominant trend that is consistently predicted by academic, government, and industry analyses. Therefore, it is appropriate for prospective electricity cost modeling to assume that the costs of maturing and evolving renewable technologies such as solar PV and CSP will decline relative to the cost of conventional technologies over time. The tumultuous pricing of wind projects in recent years makes it more challenging to predict the future cost of wind energy. Wind is still a maturing

[2] http://www.cera.com/aspx/cda/public1/news/pressReleases/pressReleaseDetails.aspx?CID=9505

technology, as the wind industry is still relatively small compared to the fossil fuel electricity generation industry. If the factors driving recent wind cost increases reflect short-term market events rather than a long-term reversal to the historical trend, then it is reasonable to expect that wind costs will decline from current levels in the future.

3. Recommended Capital Cost Value Ranges for Solar and Wind Technologies

As mentioned above, there is broad consensus that the cost of concentrating solar power and photovoltaic systems will fall in coming years (see figures below). The various rates of cost decline for these technologies as projected by several government and industry studies are listed in Table 1 below the figures.[3] In general, these studies assume more aggressive cost reductions for PV generation than for CSP generation. Every report listed in Table 1 assumes that solar generation capital costs will decrease in the future. Even the most conservative of these estimates – which are contained in the EIA Annual Energy Outlook – predict that the costs of PV and CSP projects will significantly decline between now and 2030.

Based on this consensus, we recommend that LTPP modeling efforts assume in the base case that the overnight capital cost of a concentrating solar power system located in California declines from today's level of approximately $4500/kW to $3400/kW by 2020 and $3000/kW (in real dollars) by 2025. These projections represent a constant reduction rate from 2010 to 2025 of approximately 2.7% per year – which is the median annual reduction rate from the nine estimates of future CSP costs listed in Table 1. The assumed starting cost of $4500/kW in 2010 is consistent with the assumption used for the RETI analysis. We also recommend using an uncertainty range of $2400–$4000/kW in 2020, reflecting the potential effect of aggressive industry growth at the low end or unexpectedly slow industry progress at the high end.

For central-station solar photovoltaic projects located in California, we recommend assuming a base case overnight capital cost of $4400/kWac in 2020 and $3500/kWac in 2025, which reflects a 4.5% annual reduction over the 2010-2025 timeframe from the RETI cost assumption of $7000/kWac in 2010. This is consistent

[3] The sources listed in Table 1 are not the result of an exhaustive literature review. However, we have sought to identify and include as many credible government, academic, and independent estimates of renewable technology cost projections as possible, given time constraints.

with the rate of cost reduction assumed by the 11 analyses of prospective PV costs in Table 1.[4] The median annual rate of cost reduction across these studies is 4.8%, and the average is 4.1%. We also recommend using an uncertainty range of $2500-$5000/kWac in 2020 for these projects.

The costs of distributed PV systems are likely to be slightly higher than those of their central-station counterparts, due to higher retail costs for modules and relatively higher balance-of-system costs. As a result, it is reasonable to assume that distributed PV costs will decline to $4800/kWac in 2020, with an uncertainty range of $2800-$5500/kWac. Our recommended base-case cost for distributed PV systems of $4800/kWac in 2020 is significantly higher than the $3500/kW cost that Southern California Edison has forecast for its application to install 250 MW of rooftop PV in its service territory in the next five years.[5] Furthermore, we excluded from Table 1 several industry reports and analyses that predict much more aggressive cost reductions than the assumptions we recommend for use in the LTPP base case analysis.

For wind, we recommend starting at today's price of roughly $2500/kW (using the average value from the RETI Phase 1B draft report), and then declining to $2000/kW in 2020. This assumes that many of the current supply constraints driving up wind turbine prices will ease in the next few years. As mentioned earlier, a confluence of factors suggest that the recent escalation in wind prices will not become a long-term trend, and that wind costs may at least partially revert to their historic trend of generally declining cost. A more even exchange rate between the dollar and the euro, the planned expansion in domestic wind manufacturing capacity, and the potential adoption of a more stable long-term policy to support wind energy such as a national RPS or a long-term extension to the federal Production Tax Credit are all factors that will put downward pressure on wind turbine prices.

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[4] The analyses in Table 1 all contain estimates of the cost of distributed PV systems, or, in one case, the cost of modules only. However, it can be assumed that the cost of central station PV generation will experience similar cost reductions due to the strong similarities in the underlying costs of both central station and distributed PV systems.

[5] http://www.edison.com/pressroom/pr.asp?bu=&year=0&id=7002

Figure 1. Comparison of Capital Cost Projections for Solar Thermal Generation

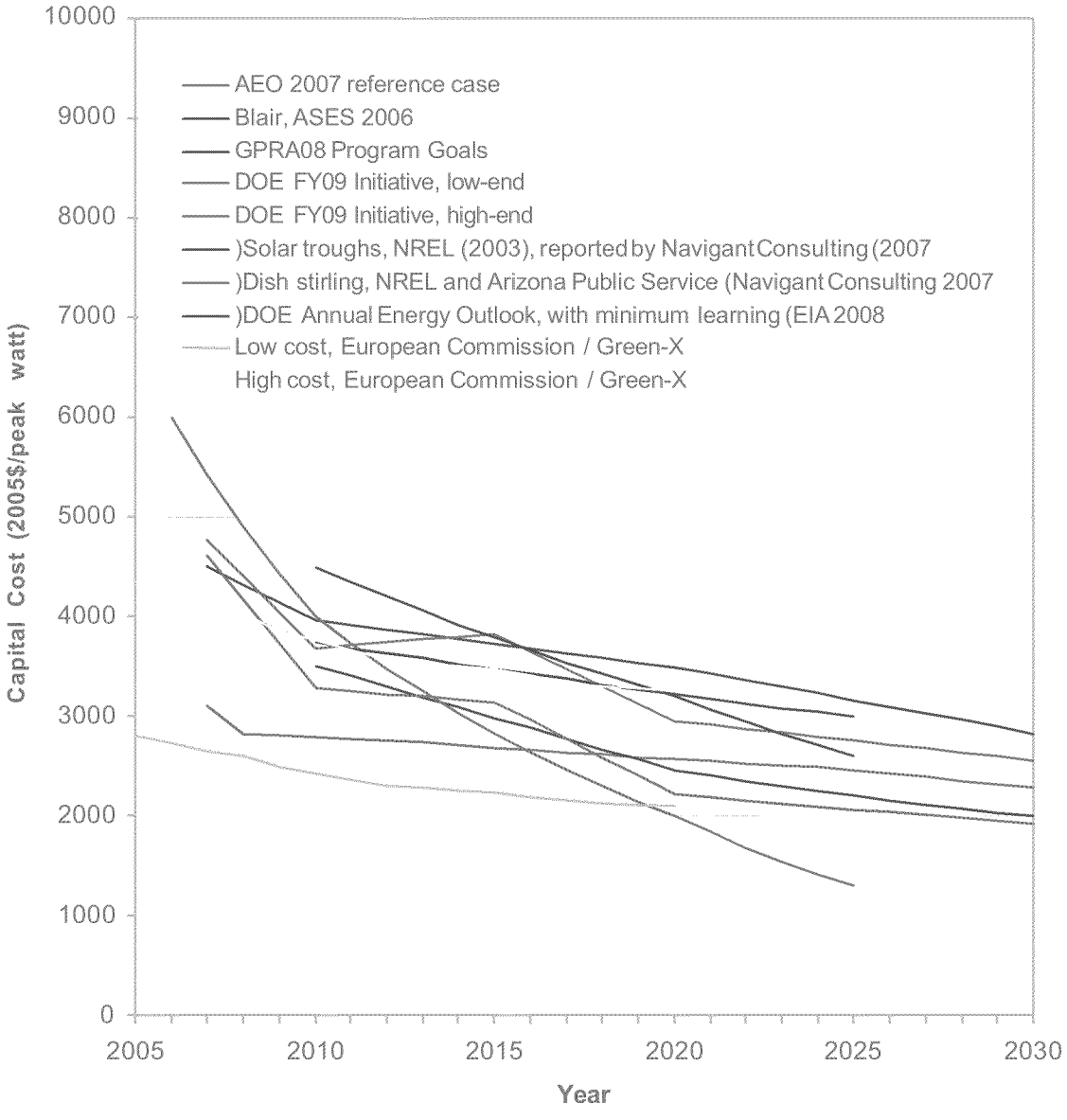

Figure 2. Historical Cost Data and Future Cost Projections for PV Systems

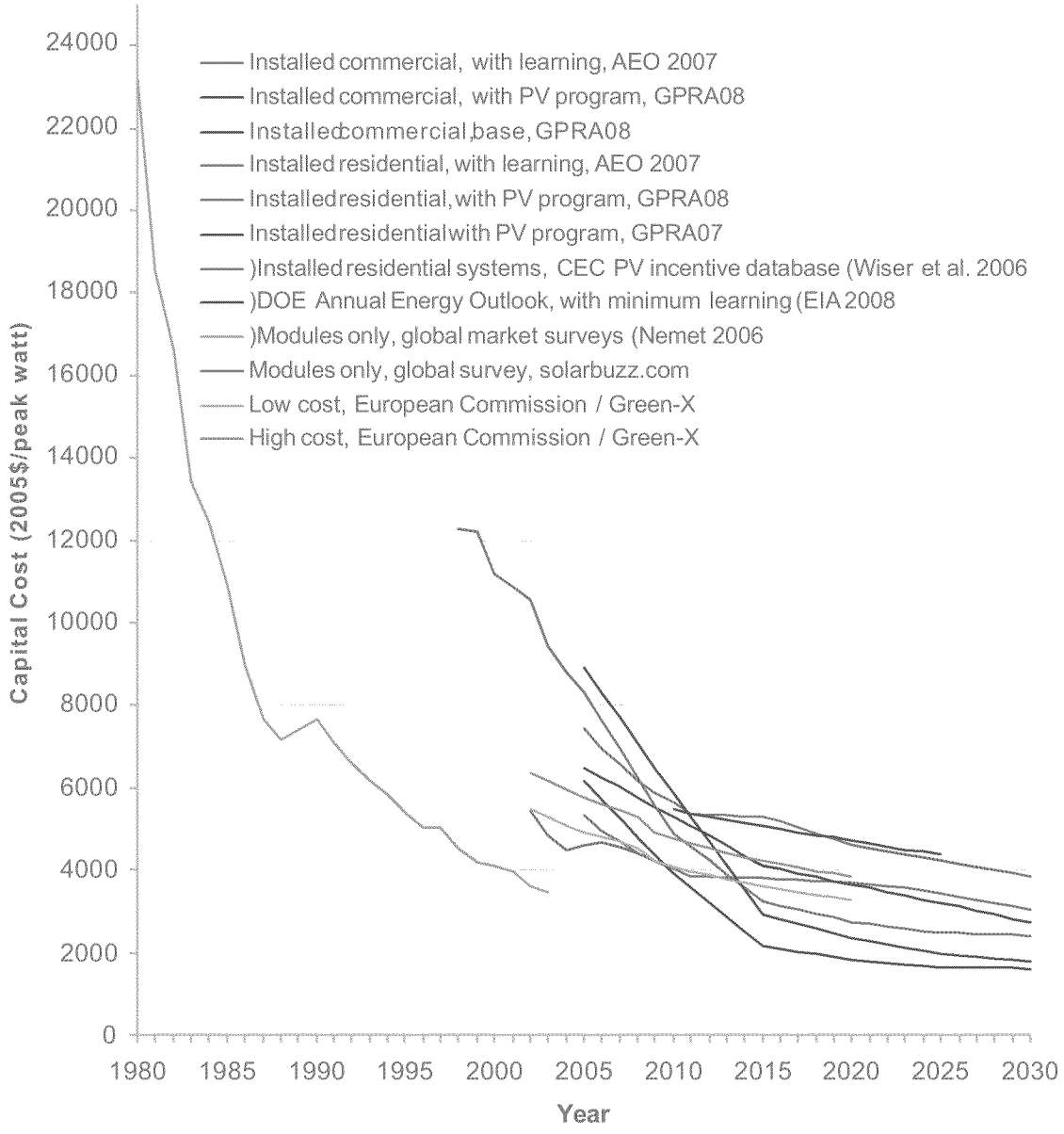

Table 1. Comparison of Renewable Technology Cost Projections Assumed by Government, Academic, and Independent Analyses

Technology	Date Range	Annual Change	Notes / Source
Solar Photovoltaic	1987–2003	–4.9%/year	Modules only, global market surveys (Nemet 2006)
	1998–2005	–5.0%/year	Installed residential systems, CEC PV incentive database (Wiser et al. 2006)
	2006–2025	–6.2%/year	Installed residential systems, industry interviews (Navigant Consulting 2007)
	2010–2025	–1.5%/year	DOE Annual Energy Outlook, with minimum learning (EIA 2008)
	2005–2030	–2.2%/year	Installed commercial, with learning, AEO 2007
	2005–2030	–5.2%/year	Installed commercial, with PV program, GPRA08
	2005–2030	–3.4%/year	Installed commercial, base, GPRA08
	2005–2030	–2.6%/year	Installed residential, with learning, AEO 2007
	2005–2030	–4.8%/year	Installed residential, with PV program, GPRA08
	2005–2030	–6.2%/year	Installed residential with PV program, GPRA07
	2002–2020	–2.8%/year	European Commission Roadmap / Green-X (EC 2007; Ragwitz et al. 2003; Ragwitz et al. 2005)
Solar Thermal	2007–2030	–1.3%/year	AEO 2007 reference case
	2007–2030	–2.0%/year	Blair, ASES 2006
	2010–2030	–2.8%/year	GPRA08 Program Goals
	2007–2030	–2.7%/year	DOE FY09 Initiative, low-end
	2007–2030	–3.7%/year	DOE FY09 Initiative, high-end
	2010–2025	–3.6%/year	Parabolic troughs, from NREL (2003), reported by Navigant Consulting (2007)
	2010–2025	–3.6%/year	Dish Stirling, from NREL and Arizona Public Service (Navigant Consulting 2007)
	2010–2025	–1.5%/year	DOE Annual Energy Outlook, with minimum learning (EIA 2008)
	2002–2020	–1.9%/year	European Commission Roadmap / Green-X (EC 2007; Ragwitz et al. 2003; Ragwitz et al. 2005)
Onshore Wind Farms	1981–2000	–3.5%/year	Onshore, Danish and German project reports (Neij et al. 2003)
	1990–2001	–5.5%/year	Onshore, Spanish project reports (Junginger et al. 2005)
	2008–2025	–2.8%/year	Onshore, EWEA forecast (Zervos and Kjaer 2008)
	2010–2025	–0%/year	Onshore, Annual Energy Outlook, minimum learning (EIA 2008)
	2002–2020	–1.7%/year	European Commission Roadmap / Green-X (EC 2007; Ragwitz et al. 2003; Ragwitz et al. 2005)

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Woodall, B. (2008). "U.S. Solar Field Foresees Cost Parity with Coal, Gas." *Reuters*. http://www.reuters.com/article/environmentNews/idUSTRE49F7OH20081016?sp=true.

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APPENDIX D

Curriculum vitae for Dr. Matthias Fripp

MATTHIAS FRIPP *curriculum vitae*

Assistant Professor of Electrical Engineering, University of Hawaii at Manoa mfripp@hawaii.edu

EDUCATION

Ph.D., Energy and Resources Group
University of California, Berkeley, December 2008

DISSERTATION SYNOPSIS: *Optimal use of Wind and Solar Power in California, 2010-2025*. I developed *Switch*, a power system planning model that identifies the ideal size and location of new renewable and conventional generators and transmission capacity in large power systems over a multi-decade period. This is the first optimization model to consider hourly electricity loads and renewable power production at hundreds of sites. I found that with moderate demand-side flexibility California could cost-effectively reduce emissions 90% or more below 1990 levels. I also found that renewable energy deployment is likely to be limited by economic factors (e.g., overproduction in off-peak hours) rather than technical factors (e.g., underproduction during peak-demand hours).

ADVISORS: Profs. Alexander E. Farrell and Daniel M. Kammen

M.S., Energy and Resources
University of California, Berkeley, May 2003

AREA OF FOCUS: physics and materials science of renewable energy systems

MASTER'S PROJECT: *Now You See It, Now You Don't: The Metastable Defect in Czochralski Silicon* (electronic analysis of silicon used for solar cells)

ADVISOR: Prof. Eicke R. Weber

B.A., Environmental Studies
Lewis & Clark College, Portland, Ore., May 1999

AREAS OF FOCUS: energy and environmental economics, consumer behavior

THESIS: *Racing Down the Experience Curve: policies to accelerate the use of renewable energy*

ADVISOR: Prof. Eban S. Goodstein

HONORS, GRANTS and FELLOWSHIPS

NextEra Research Fellowship in Renewable Energy, Oxford University, 11/08–4/12

Outstanding Young Alumnus, Lewis & Clark College, 2011

U.S. EPA Science to Achieve Results (STAR) graduate fellowship, 8/06–12/08

U.S. NSF Doctoral Dissertation Research Improvement Grant, 3/06–8/06

Berkeley Fellowship, University of California, Berkeley, 8/01–12/06

Departmental Honors, Environmental Studies; Degree with Distinction (*summa cum laude*); Lewis & Clark College, 5/99

Inducted into Phi Beta Kappa honor society, Lewis & Clark College, 5/99

Fellow, Dr. Robert B. Pamplin, Jr., Society of Fellows, 9/96–5/99
(Lewis & Clark College's highest academic honor)

R. Harold Burton Achievement Scholarship, Lewis & Clark College, 9/97–5/99

Cheney Foundation Scholarship, Lewis & Clark College, 9/96–5/97

Dean's Scholarship, Lewis & Clark College, 9/95–5/99

Assistant Professor of Electrical Engineering, University of Hawaii at Manoa mfripp@hawaii.edu

PUBLICATIONS

Matthias Fripp and Brian Krohn (in review), "Life-Cycle Greenhouse Gas Emissions from Renewable, Nuclear and Carbon-Capture Power Plants."

Matthias Fripp (2012), "Switch: A Planning Tool for Power Systems with Large Shares of Intermittent Renewable Energy," *Environmental Science & Technology* 46(11): 6371–6378.

James Nelson, Josiah Johnston, Ana Mileva, **Matthias Fripp,** Ian Hoffman, Autumn Petros-Good Christian Blanco, and Daniel M. Kammen (2012), "High-resolution modeling of the western North American power system demonstrates low-cost and low-carbon futures," *Energy Policy*.

Brian Krohn and **Matthias Fripp** (2012), "A Life Cycle Assessment of Biodiesel Derived from the 'Niche Filling' Energy Crop Camelina in the USA," *Applied Energy*.

Matthias Fripp (2011), "Greenhouse Gas Emissions from Operating Reserves Used to Backup Large-Scale Wind Power," *Environmental Science & Technology*.

Matthias Fripp (2009), "Life-Cycle Greenhouse Gas Emissions From Clean Coal, Clean Gas and Wind Generators," Environmental Change Institute, Oxford University.

Diana Poputoaia and **Matthias Fripp** (2008), *European Experience with Tradable Green Certificates and Feed-In Tariffs for Renewable Electricity Support,* Environmental Change Institute, Oxford University.

Matthias Fripp and Ryan H. Wiser (2008), "Effects of Temporal Wind Patterns on the Value of Wind-Generated Electricity at Sites in California and the Northwest," *IEEE Transactions on Power Systems* 23(2): 477-485.

Asher Ghertner and **Matthias Fripp** (2007), "Trading Away Damage: Quantifying Environmental Leakage through Consumption-Based, Life-Cycle Analysis," *Ecological Economics* 63: 2-3: 563-577.

Matthias Fripp and Ryan H. Wiser (2006), *Analyzing the Effects of Temporal Wind Patterns on the Value of Wind-Generated Electricity at Different Sites in California and the Northwest*, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, LBNL-60152. Berkeley, CA.

Richard McCann, Dallas Burtraw, **Matthias Fripp** and Steven Moss (2005), "Recommendations for the design of modeling and analysis of the electricity sector to guide options for climate policy in California," in *The Berkeley Climate Policy Study: Potential Economic Costs and Benefits of Climate Change Policy in California*, edited by W. Michael Hanemann and Alexander E. Farrell. California EPA.

Kamal H. Kapadia, **Matthias Fripp** and Daniel M. Kammen (2004), *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* Renewable and Appropriate Energy Laboratory (RAEL) Report, University of California, Berkeley, 2004.

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CONFERENCE AND WORKSHOP PRESENTATIONS

Matthias Fripp (2012), "Greenhouse Gas Emissions from Reserves Used to Backup Large-Scale Wind Power," Association of American Geographers Annual Conference, New York City, NY, February 24–28.

Matthias Fripp (2011), "Greenhouse Gas Emissions from Operating Reserves Used to Backup Large-Scale Wind Power," Utility Wind Integration Group Fall Technical Workshop, Lahaina, Maui, HI, October 11–14.

Matthias Fripp (2010), "The Cost of Using Wind and Solar Power to Achieve Radical Greenhouse Gas Emission Reductions," Association of American Geographers Annual Conference, Washington, DC, April 14–18.

Matthias Fripp (2009), "Optimal Investment in Wind and Solar Power in California, 2010-2025," invited presentation, Chair's Air Pollution Seminar, California Air Resources Board, February 17.

Matthias Fripp (2009), "Optimal Investment in Wind and Solar Power in California," invited presentation, California Public Utility Commission, February 13.

Matthias Fripp (2007), "Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?" invited presentation, Employment Effects of Renewable Energy Systems workshop, German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, April 24.

Matthias Fripp and Ryan H. Wiser (2006), "Effects of Temporal Wind Patterns on the Value of Wind-Generated Electricity at Different Sites in California and the Northwest," United States Association for Energy Economics, 26th USAEE/IAEE North American Conference, Ann Arbor, MI, September 24–27.

Matthias Fripp and Ryan H. Wiser (2005), "Does Location Matter? Analyzing the Effects of Temporal Wind Patterns on the Value of Wind-Generated Electricity at Different Sites in California and the Northwest," American Wind Energy Association, WindPower 2005, Denver, CO, May 15–18.

PROFESSIONAL EXPERIENCE

Assistant Professor of Electrical Engineering
University of Hawaii at Manoa, June 2012 – present

Studying the technical and economic performance of power systems with large shares of renewable power; teaching graduate and undergraduate courses on power systems, power conversion and renewable energy.

NextEra Research Fellow in Renewable Energy
University of Oxford (UK), Nov. 2008 – April 2012

Modeled the technical and economic performance of power systems with large shares of renewable power on long and short time scales. Supervised master's and Ph.D. students and research assistants. Conducted a course on Energy Resource Assessment – calculating costs, land-use, environmental impacts and other aspects of energy production and consumption.

PROFESSIONAL EXPERIENCE, continued

Consultant
Union of Concerned Scientists, Berkeley, California, Aug. 2008 – Aug. 2009

Helped write stakeholder comments for a California Public Utilities Commission proceeding on the cost of a 33% renewable electricity standard.

Graduate Student Instructor (teaching assistant)
"Energy and Society", University of California, Berkeley, Aug. – Dec. 2007

Taught graduate and undergraduate students about the socioeconomic, technical and environmental dimensions of energy production and consumption.

Graduate Student Instructor (teaching assistant)
"Quantitative Aspects of Global Environmental Problems",
University of California, Berkeley, Jan. – May 2007

Helped to teach a broad environmental science class, covering stocks and flows in the environment, acid deposition and global climate.

Research Assistant
Lawrence Berkeley National Laboratory, May 2003 – July 2006
Energy, Markets and Policy group, Environmental Energy Technologies Division

Assessed the effect of temporal patterns of wind speeds on the market value and firm capacity contribution of wind power at sites throughout California and the Pacific Northwest.

Information Systems Consultant (volunteer)
Sarvodaya Shramadana Movement, Colombo, Sri Lanka, Feb. – Sept. 2005

Led the establishment of geographic and management information systems to identify rural needs and track the progress of tsunami-relief and development projects at Sri Lanka's largest grassroots development organization.

Chief Modeler
Trexler and Associates, Inc., Portland, Ore., January 2000–July 2001

Assessed climate change mitigation projects, technologies and policy. Modeled the financial results of corporate climate change mitigation activities.

Summer Researcher
Renewable Northwest Project, Portland, Ore., May–July 1999

Created fact sheets on the economics and technology of wind, solar and geo-thermal energy. Researched green power programs for legislative testimony.

Chief Editor, Staff Writer
Pioneer Log newspaper, Lewis & Clark College, Portland, Ore, 1995–1999

Designed, edited and published the college's weekly student newspaper. Recruited and trained staff members. Wrote weekly news articles.

Peer Tutor in Writing
Writing Center, Lewis & Clark College, Portland, Ore, Spring 1996, Spring 1997

Worked one-on-one with students to help them improve all aspects of their writing.

PROFESSIONAL EXPERIENCE, continued

Publications and Technology Coordinator
College Outdoors, Lewis & Clark College, Portland, Ore., Jan. 1997–May 1999

Assisted with planning and promoting the college's wilderness program.

News Intern, Freelance Researcher and Writer
Willamette Week, Portland Oregon, June 1998–March 1999

Researched and wrote articles for Portland's leading weekly newspaper.

Membership Director, Information Systems Manager, Database Analyst, Graphic Designer, Copy Editor
Best Friends Animal Sanctuary, Kanab, Utah, October 1991–July 1997; June 2002

Worked with two colleagues to establish the direct-mail program which supports the nation's largest non-euthanizing animal rescue organization.

VERIFICATION

I, Laura Wisland, am a representative of the Union of Concerned Scientists and am authorized to make this verification on the organization's behalf. The statements in the foregoing document are true to the best of my knowledge, except for those matters that are stated on information and belief, and as to those matters I believe them to be true.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 22, 2012, in Berkeley, California.

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