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**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA**

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| Order Instituting Rulemaking to Implement the Commission's Procurement Incentive Framework and to Examine the Integration of Greenhouse Gas Emission Standards into Procurement Policies. | ) | Rulemaking 06-04-009 (Filed April 13, 2006) |

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# REPLY COMMENTS OF SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E) ON MODELING-RELATED ISSUES


MICHAEL D. MONTOYA
LAURA I. GENAO
CATHY A. KARLSTAD

Attorneys for
SOUTHERN CALIFORNIA EDISON COMPANY

2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770
Telephone: (626) 302-1096
Facsimile: (626) 302-1904
E-mail: Cathy.Karlstad@sce.com


Dated: **January 18, 2008**

**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE**

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# REPLY COMMENTS OF SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E) ON MODELING-RELATED ISSUES

Pursuant to the Administrative Law Judges' Ruling Extending Comment Deadlines and Addressing Procedural Matters, issued November 30, 2007, Southern California Edison Company ("SCE") respectfully submits these reply comments on the documentation for the model created by Energy and Environmental Economics, Inc. ("E3") to assess how different methods of reducing greenhouse gases ("GHG") will achieve emission reduction goals for the electricity sector and how such reductions will affect utility costs and consumers' electricity bills.

## I.

## GHG EMISSIONS COSTS SHOULD BE INCORPORATED INTO THE OPERATING COSTS OF GENERATING FACILITIES

In its opening comments, the Southern California Public Power Authority ("SCPPA") asserts that incorporating GHG emissions costs into the operating costs of generating facilities to alter dispatching should not be considered an appropriate emission reduction measure.[1] In particular, SCPPA argues that the "adverse impact of internalizing the cost of GHG emissions in wholesale electricity prices could be substantial and could have a profoundly adverse economic impact on consumers."[2] SCPPA relies on an analysis presented in this proceeding by Bruce Biewald of Synapse Energy, Inc.[3] SCE disagrees with SCPPA. Incorporating GHG emissions costs into the operating costs of generating facilities is a cost-effective and efficient way to reduce emissions.

Internalizing emissions costs allows the market to find the lowest cost options to reduce GHG emissions. When emissions costs are internalized into the operating costs of generating facilities, and thus into wholesale power prices, there is a price signal to the market which creates an economic incentive to reduce GHG emissions. Sending this price signal to the market encourages energy efficiency, conservation, development of clean resources, and innovation in new clean technology, without the need for complex and difficult to administer regulations. Regulators do not have the burden to administratively determine the most effective means to reduce GHG emissions. The price signal to the market incentivizes the most cost-effective GHG reduction options.

Furthermore, while internalizing GHG emissions costs will increase the cost of power, utilizing a market will be more cost-effective than command and control measures in reducing GHG emissions. According to the Electric Power Research Institute ("EPRI"), command and

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[1] SCPPA Opening Comments at 2-5.
[2] *Id.* at 4.
[3] *Id.*

control GHG regulations would diminish economic welfare 30% more than a comprehensive market system.[4]

Finally, the Synapse Energy, Inc. analysis relied on by SCPPA in its opening comments is flawed. For the reasons stated in the SCE/Pacific Gas and Electric Company ("PG&E") presentation attached hereto as Appendix A, the Synapse Energy, Inc. model has significant flaws and the results distort the economic impacts under load-based and source-based GHG emissions caps, greatly overstating the benefits of a load-based cap. Neither E3 nor the California Public Utilities Commission ("CPUC") and California Energy Commission ("CEC") should not use the Synapse Energy, Inc. analysis in their GHG modeling efforts.

## II.

## E3'S MODEL IS NOT APPROPRIATE TO ANALYZE GHG SCENARIOS ON A LOAD-SERVING ENTITY BASIS

SCE's opening comments explain that, although E3's data assumptions and modeling approach will provide results that may be appropriate for a statewide analysis of GHG scenarios in the electricity sector, E3's analysis is not appropriate on an individual load-serving entity ("LSE") basis. Among other things, E3 appears to use the same emission rates for each fuel type, which may result in inaccurate GHG emissions levels, especially for those emissions from combined cycle units burning natural gas. Moreover, E3's modeling assumptions reflect specific information pertaining to the five largest electric utilities in California, but minimal information pertaining to the many other LSEs operating within California. Modeling GHG scenarios for some, but not all, California LSEs will lead to inaccurate information and could lead to decisions that are not only inaccurate but more costly to implement. Finally, E3's modeling assumption that an LSE that owns a generator or has entered into a power purchase agreement with a

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[4] EPRI, Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach, Volume 1: Summary for Policymakers at § 3.2.2, 3-6 (June 2007) (available at www.epriweb.com/public/000000000001014641.pdf).

generator is allocated that unit's energy proportional to the ownership share is problematic. While that assumption may be correct for a market that operates without bilateral agreements and where all contracts for capacity include exclusive assignment of generated energy, this scenario does not reflect either the current or projected future operation of the California electricity market. An LSE with a contract for a unit's capacity may not have any contractual commitment for the unit's energy, and bilateral agreements exist between entities that allow energy transfer without capacity transfer. Therefore, E3's assumptions do not reflect actual operating conditions.

Other parties' opening comments support SCE's conclusion that E3's modeling is problematic at the LSE level. The Northern California Power Agency ("NCPA") states that E3's model does not provide accurate or adequate information about publicly-owned utilities.[5] Similarly, the Sacramento Municipal Utility District ("SMUD") asserts that E3 failed to accurately attribute all of SMUD's specified resources to SMUD.[6] San Diego Gas & Electric Company ("SDG&E") and Southern California Gas Company ("SoCalGas") note that they disagree with most of the assumptions in the E3 model used to derive entity-specific results.[7] Finally, the Los Angeles Department of Water and Power ("LADWP") notes the problems with E3's assumptions about LSE resource planning in 2020, and states that "unintended consequences can arise" when extrapolating E3's modeling to LSE-specific results as would be done in Stage 2.[8]

SCE agrees with these parties' concerns regarding the accuracy of LSE-specific results in E3's modeling and the application of the E3 model to GHG scenarios at the LSE level. For these reasons, SCE believes the E3 model should not be applied to model scenarios on an individual LSE basis. Moreover, as SCE has explained in prior comments, accounting for GHG emissions under a source-based or first seller approach is more accurate then accounting for such emissions

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[5] NCPA Opening Comments at 2.
[6] SMUD Opening Comments at 7.
[7] SDG&E/SoCalGas Opening Comments at 8.
[8] LADWP Opening Comments at 5-9.

under a load-based approach. Therefore, E3's modeling of actual GHG emissions will be more accurate if a source-based or first seller model is used.[9]

## III.

## E3 SHOULD MODEL DIFFERENT FUEL PRICE SCENARIOS

In their opening comments, the Natural Resources Defense Council ("NRDC") and the Union of Concerned Scientists ("UCS") assert that:

> In its current form, the E3 model does not account for the effect of increased reliance on preferred resources on reducing natural gas prices. Instead, the E3 model assumes that natural gas prices are unchanged between the reference and the target cases, even though natural gas demand may be much lower in the target case. The assumption that natural gas prices will not be affected by substantially reduced demand is a significant oversight of the E3 model.[10]

SCE has reviewed the documents referenced by NRDC/UCS in their comments and acknowledges the potential for decreased natural gas demand within the electricity sector based upon two main factors:

1. Replacing old, less efficient simple-cycle peaker gas units with new, more efficient CHP/CC gas units will allow the same (or more) energy to be produced while burning less fuel; and

2. An increase in renewable energy and implemented energy efficiency measures will displace a proportionate share of energy from marginally priced natural gas units.

Without diminishing the validity of NRDC/UCS's concern, however, it is important to look at the other side of the coin and consider that another section within the CEC's 2007 Integrated Energy Policy Report includes a scenario describing how natural gas could be used as

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[9] The Western Power Trading Forum's ("WPTF") opening comments note that because E3's GHG calculator was developed to model a load-based approach, it cannot quantity the benefits of alternative systems such as a source-based approach or a first seller approach as currently configured. WPTF Opening Comments at 9. SCE supports a first seller regulatory approach to satisfying the State's GHG abatement goals. Incorporating a first seller model into the GHG calculator would provide a more realistic assessment of a first seller approach. Because this calculator models a load-based cap, it does not include emissions costs in the dispatch price. In a first seller approach, the emissions cost would be included in the dispatch price.

[10] NRDC/UCS Opening Comments at 17.

a complementary strategy to meet GHG emissions reductions.[11] This scenario and a subsequent recommendation discuss how the demand for natural gas could increase under a strategy to displace coal power plants in the Western Electricity Coordinating Council ("WECC") and the eastern United States with natural gas fired power plants.[12]

Rather than initiating a potentially time consuming discussion on the appropriate fuel prices to use in PLEXOS for production cost/economic dispatch modeling purposes, SCE believes E3's intent is to use their GHG calculator as a means to efficiently and quickly evaluate scenarios and analyze sensitivity cases, which of course should include changes in fuel prices. These analyses would help determine the feasibility of different emissions scenarios under a range of fuel prices while avoiding a prolonged process of determining a "correct" natural gas forecast.

## IV.

## E3'S TREATMENT OF WIND INTEGRATION COSTS SHOULD BE CLARIFIED

As SCE explained in its opening comments, E3 should clarify its treatment of wind integration costs. In particular, E3's graphical display using wind penetration in % MW[13] and then in % GWh[14] should be revised for consistency. E3's reference to 30,000 GWh of wind energy having a wind integration cost of $275 million may suggest that 30,000 GWh is synonymous with 30% wind capacity penetration. However, 30,000 GWh is more closely associated with 20% wind capacity penetration using E3's assumed control area size of 50,000 MW and wind capacity factor of 34%. The wind integration costs for 30% wind capacity for the 50,000 MW control area assumed by E3 would, using E3's values, have an associated cost of over $400 million. When calculated for a control area with a coincident peak of 70,000+ MW

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[11] CEC 2007 Integrated Energy Policy Report at 241-42.

[12] *Id.*

[13] E3's CPUC GHG Modeling Stage 1 Documentation at 145, Fig. 5 (http://www.ethree.com/GHG/R0604009_ Attachment _B_v2.pdf).

[14] *Id.* at 146, Fig. 6.

(*i.e.*, the CEC's projected demand for California beyond 2018),[15] the values would be significantly higher. The tables below clarify the treatment of wind integration costs.

E3's Wind Integration Costs (Chapter 28)

| Back Calculated | Assumed | Back Calculated | Assumed | Assumed | Assumed | Calculated |
|---|---|---|---|---|---|---|
| | | | | Starting Point | | Cost |
| Percent Penetration (%) | System Capacity (MW) | Wind Capacity (MW) | Capacity Factor (%) | Wind Energy (GWh) | ($/MWh) | $ |
| 6.7% | 50,000 | 3,358 | 34% | 10,000 | 3.13 | $ 31,300,000 |
| 13.4% | 50,000 | 6,715 | 34% | 20,000 | 6.26 | $ 125,200,000 |
| 20.1% | 50,000 | 10,073 | 34% | 30,000 | 9.39 | $ 281,700,000 |

E3 10,000 GWh of wind energy is implied to be equivalent to 10% MW penetration of wind capacity, which is incorrect
Implied Conclusion: Wind integration costs are $30 Million for 10% penetration, $125 Million for 20% penetration, and $280 Million for 30% penetration

SCE's Wind Integration Costs using E3's Values and a Calculated Wind Energy for Assumed MW penetration value

| Assumed | Assumed | Calculated | Assumed | Calculated | Assumed | Calculated |
|---|---|---|---|---|---|---|
| Starting Point | | | | | | Cost |
| Percent Penetration (%) | System Capacity (MW) | Wind Capacity (MW) | Capacity Factor (%) | Wind Energy (GWh) | ($/MWh) | $ |
| 10.0% | 50,000 | 5,000 | 34% | 14,892 | 3.13 | $ 46,611,960 |
| 20.0% | 50,000 | 10,000 | 34% | 29,784 | 6.26 | $ 186,447,840 |
| 30.0% | 50,000 | 15,000 | 34% | 44,676 | 9.39 | $ 419,507,640 |

Conclusion: Wind integration costs are $45 Million for 10% penetration, $185 Million for 20% penetration, and $420 Million for 30% penetration

## V.

## IMPLEMENTATION OF A 33% RENEWABLES PORTFOLIO STANDARD PRESENTS SIGNIFICANT CHALLENGES

NRDC/UCS's opening comments argue that "California should immediately adopt a 33% Renewables Portfolio Standard (RPS) to ensure the development of additional renewable resources to serve the state."[16] NRDC/UCS assert that "[t]he CEC Intermittency Analysis Project (IAP) concludes the state's electricity system, if bolstered by transmission upgrades and

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[15] CEC 2007 Integrated Energy Policy Report at 45.
[16] NRDC/UCS Opening Comments at 7.

prudent resource planning, can readily accommodate 33% renewables penetration with minor changes to system operation and infrastructure."[17]

SCE has discussed the need for legislation in order to adopt a 33% RPS requirement and other challenges surrounding a 33% RPS in other forums and does not repeat that discussion here.[18] SCE does note, however, that NRDC/UCS significantly understate the challenges of implementing a 33% RPS. SCE agrees with PG&E's opening comments that major issues associated with expanded renewables procurement still need to be resolved.[19]

A recent California Independent System Operator ("CAISO") study regarding the integration of renewable resources concludes that:

> The good news is that this study shows the feasibility of maintaining reliable electric service with the expected level of intermittent renewable resources associated with the current 20 percent RPS, *provided* that existing generation remains available to provide back-up generation and essential reliability services. The cautionary news is the "*provided*" part of our conclusion. Regulatory actions under active consideration threaten the economic viability of much of this essential generation. Moreover, current regulatory policies assigning high on-peak availability factors to intermittent generation will eliminate the theoretical — but not the real — need for the essential generation currently provided by existing power plants, and regulators may be unwilling to support sufficient forward procurement of generation.[20]

Furthermore, in discussing the CEC's IAP, the CAISO states that "[i]t would be erroneous to conclude that there are no serious integration problems" with even a 20% RPS.[21] Contrary to NRDC/UCS's suggestion that the changes to system operation and infrastructure needed to accommodate a 33% will be "minor," the CAISO notes that the IAP report concluded that "[m]ajor new transmission facilities and upgrades of existing transmission will be required

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[17] *Id.*

[18] *See, e.g.*, Southern California Edison Company's 2006 Procurement Plan Volume 1B, R.06-02-013, at 74-88 (Dec. 11, 2006).

[19] PG&E Opening Comments at 17-23.

[20] CAISO, Integration of Renewable Resources, Transmission and operating issues and recommendations for integrating renewable resources on the California ISO-controlled Grid, Letter from CEO (November 2007) (emphasis added) (available at http://www.caiso.com/1ca5/1ca5a7a026270.pdf).

[21] *Id.* at 19.

for the 20% RPS and especially to accommodate the 33% RPS goal."[22] The CAISO also concludes that increasing the RPS from 20% to 33% could more than double integration costs and problems:

> The variability of wind generation energy production from a small number of units is usually much less than the variability of system load changes. The system operator is accustomed to dealing with daily load forecast errors, changes in hourly load forecasts and the unpredictability of loads. As the amount of wind generation in an area increases, it will reach a point where its variability is greater than the variability of load. As wind generation further increases, the amount of variability will increase non-linearly. This study focused on the 20% RPS. An increase of the RPS to 33% could more than double the integration problems and costs.[23]

SCE shares PG&E's concern that the CPUC and the CEC adequately evaluate all of the challenges associated with GHG emissions reductions from incremental renewables.

## VI.

## CARBON CAPTURE AND SEQUESTRATION SHOULD BE CONSIDERED AS A GHG EMISSIONS REDUCTION OPTION

The Green Power Institute's ("GPI") opening comments state that until there is "a sound demonstration of the technical viability of carbon sequestration," carbon capture and sequestration ("CCS") "should not be considered as a real option for meeting greenhouse gas emissions reduction goals in any timeframe of interest to planners and regulators."[24] SCE disagrees. SCE believes that CCS technology has the potential to reduce GHG emissions, and has submitted an application with the CPUC to perform a feasibility study of a clean hydrogen generation plant.[25] No environmental parties to that proceeding (which include Californians for Renewable Energy, The Utility Reform Network, and NRDC) claimed that CCS was not ripe for

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[22] *Id.* at 20.
[23] *Id.* at 14 (emphasis added).
[24] GPI Opening Comments at 4.
[25] A.07-05-020.

consideration.[26] The CPUC recently issued a proposed decision granting SCE's application.[27] Moreover, the National Energy Technology Laboratory (of the Department of Energy) projects that by 2012, it will have developed CCS technologies with 99% permanence.[28] CCS should not be excluded as an option for reducing emissions to meet the State's AB 32 goals.

## VII.

## E3 SHOULD PROVIDE MORE DETAILED DOCUMENTATION EXPLAINING ITS MODEL

SCE agrees with the sentiment expressed by several parties in their opening comments that more detailed E3 modeling documentation is needed in order to assess the underlying model.[29] It is difficult to build a meaningful scenario with the current documentation, and it would be useful to have examples of scenario build-outs documented by E3 to ease calculator usability. As explained in SCE's opening comments, E3 should provide a document which captures details on values and equations listed on tabs other than the "Main" tab on its GHG calculator. E3 should also provide the other documentation requested in SCE's opening comments.[30] In addition, SCE recommends that the CPUC conduct a workshop or seminar where E3 could explain how to use the GHG calculator. Such a workshop or seminar would make it easier for the parties to use and assess E3's model, and would also provide the parties with an additional opportunity to ask E3 questions about its modeling.

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[26] NRDC/UCS support consideration of CCS as an option for meeting GHG emissions reduction goals in this proceeding. NRDC/UCS Opening Comments at 3-5.

[27] *See* Proposed Decision issued on Jan. 15, 2008 in A.07-05-020.

[28] *See* http://www.netl.doe.gov/technologies/carbon_seq/overview/images/CS%20Program%20Milestones.jpg.

[29] *See, e.g.*, SCPPA Opening Comments at 12-13; SMUD Opening Comments at 6-7; GPI Opening Comments at 7; The Independent Energy Producers Association Opening Comments at 2-3.

[30] SCE Opening Comments at 6-7.

Respectfully submitted,

MICHAEL D. MONTOYA
LAURA I. GENAO
CATHY A. KARLSTAD

/s/ Cathy A. Karlstad
By: Cathy A. Karlstad

Attorneys for
SOUTHERN CALIFORNIA EDISON COMPANY

2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770
Telephone: (626) 302-1096
Facsimile: (626) 302-1904
E-mail: Cathy.Karlstad@sce.com

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# APPENDIX A

# Customer Cost of Load-Based Cap vs. First-Seller

Pacific Gas and Electric Company™

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November 7, 2007

# Background

- Synapse Energy Economics, Inc. analyzed the differences between a Load-Based Cap and a Source-Based Cap and their corresponding economic impacts on the California electricity market. Bruce Biewald, president of Synapse, presented the findings at the CPUC/CEC Joint En Banc Hearing on August 21, 2007

- Synapse concluded that a "load side carbon cap is likely to cost California consumers significantly less than a supply side cap", to the possible extent of $5 billion annually

- However the assumptions used in the Synapse model are flawed and the results distort the economic impacts to customers under load-based and source-based caps

- Both PG&E and SCE have engaged Synapse to gain a better understanding of the model; Synapse has responded to the inquiries but PG&E and SCE both feel that deficiencies remain in the analysis

# Impacts of a Carbon Cap on Power Prices

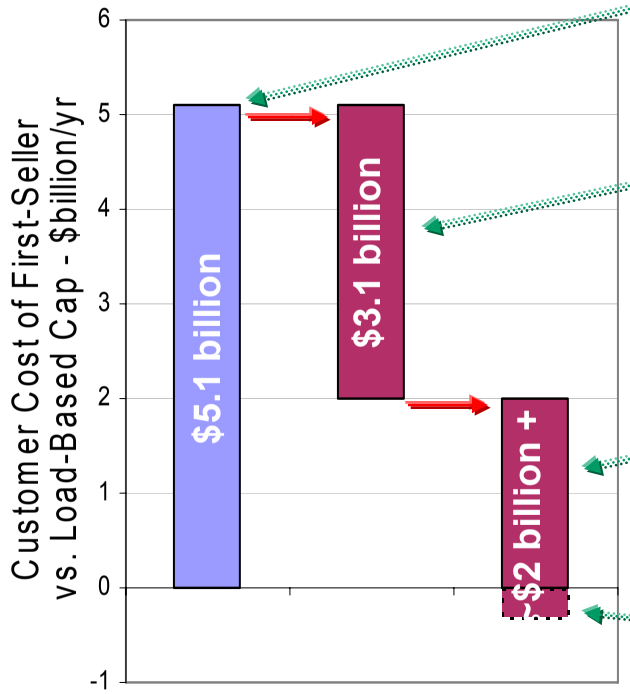
- Under a First-Seller approach:
  - Costs of emissions are internalized by generators
  - Power prices will reflect the GHG attributes of the marginal generator
- Under a Load-Based Cap:
  - The marginal generator will set the market price for electricity that excludes $CO_2$ compliance costs
  - As the point of regulation, Load-Serving Entities' (LSEs) customers will have to pay the $CO_2$ compliance cost separately

**Under a Load-Based Cap, clean generators will negotiate bi-laterally with many LSEs for contract prices that reflect the value of their "clean power", including:**

- The market price of electricity, and
- The $CO_2$ compliance costs LSEs' customers avoid by buying clean power

# Results

## Synapse Energy greatly overstated the benefits of a Load-Based Cap




A "Benefit" of $5.1 billion/year was presented by Bruce Biewald at the En Banc

But, if you allocate allowances to Load-Serving Entities (LSEs) instead of Generators, this benefit is reduced by $3.1 billion/year

And recognize that Clean Generators will negotiate higher prices with many LSEs to capture the economic value of their "clean power"

Thus, a Load-Based Cap will cost the <u>same</u> or <u>more</u> than First-Seller, depending on the default emission rate.

*[The Synapse Energy presentation was delivered by Bruce Biewald at the CPUC/CEC en banc hearing on August 21, 2007. The presentation and spreadsheet are available at: http://www.synapse-energy.com]*

## $3.1 Billion Impact of Allowance Allocation on Customer Costs

- In Synapse's presentation, allocating allowances to generators rather than LSEs on behalf of their customers increases customer costs by $3.1 billion/year.
- The point of regulation, however, should not alter the allocation of allowances.
- Synapse acknowledges that, under a generator-side cap, allowances can be allocated to generators or to LSEs.

- If you allocate allowances to Load-Serving Entities (LSEs) instead of generators, customer costs are reduced by $3.1 billion/year

# ~$2 billion: Significant Flaws in the Synapse Model

1. Synapse model ignores economic dispatch:
   - –After the CO2 cost is internalized in Source-based scenario, Synapse indicates utilities will buy more high-cost Nat Gas electricity, even though Imp Coal remains cheaper.
2. The model ignores the heat rate curve for natural gas generation:
   - –In the Load-Based Cap scenario, natural-gas-fired generation increases, but its marginal costs do not.
3. The model uses a “weighted market price”:
   - –Instead of a market-clearing price, Synapse calculates a weighted average of each dispatchable category’s Generation times its “Marg Cost”.
4. The model lacks a market clearing price:
   - –Each category of dispatchable generators, including imports, is paid that category’s “Marg Cost”, not a market-clearing price.
   - –e.g. assumes hydro is paid $55 and gas $80, even though in reality in present and future short-term markets lower-emitting and higher-emitting generators receive same electricity price.

# Utility Analysis: Customer Costs Are Similar Under Load-Based Cap and First Seller

- Overall electricity costs to customers are likely to be similar under Load-Based Cap and First-Seller, because Renewable Generators will bargain with many Load-Serving-Entities (LSEs) for full value, including LSEs' emission-compliance cost for High Emitters.

| | Merchant Generator | | |
|---|---|---|---|
| Assumptions | Renewables | GasCC | High Emitter |
| Running Cost | ~$0/MWh | $50/MWh | $25/MWh |
| Emission Cost @ $20/metric ton | $0/MWh | $8/MWh | $10/MWh |
| Today's Market | | | |
| Wholesale-Market Price (set by GasCC, excluding Emission Cost) | $50/MWh | $50/MWh | $50/MWh |
| First-Seller | | | |
| Wholesale-Market Price (set by GasCC, including Emission Cost) | **$58/MWh** | $58/MWh | **$58/MWh** |
| Load-Based Cap | | | |
| Wholesale-Market Price (set by GasCC, excluding Emission Cost) | avoid wholesale market | $50/MWh or bilateral | $50/MWh |
| Additional Emission Cost paid by LSE | $0/MWh | $8/MWh | $10/MWh |
| **Total Cost to Ratepayers** | **$58-$60/MWh** | **$58-$60/MWh** | **$60/MWh** |

**Today: LSE pays same spot price for merchant Renewables, GasCC and High Emitters, set by GasCC.**

**First-Seller: As in Today's market, LSE pays same spot price for Renewables, GasCC and High Emitters, based on marginal GasCC's emission cost.**

**Load-Based Cap: Renewables and GasCCs will bargain with many LSEs for highest contract price, including benefits of their lower CO2 emissions relative to High Emitter.**

**Load-Based Cap: Depending on level and application of default emission rate, either leakage may occur or LSEs may pay more for High Emitters and Renewables.**

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# Appendix

- Flaws in Synapse Energy's model
- Impact of default emission rate on economic impacts and leakage

# Flaws in Synapse Energy's Analysis (1)

- The Synapse analysis ignores economic dispatch
- Synapse: After the CO2 cost is internalized, Synapse indicates utilities will buy more high-cost Nat Gas electricity, even though Imp Coal remains cheaper
- Reality: Utilities will procure least-cost energy, including internalized CO2 costs

| | | No CO2 Cost | | 30 CO2 Cost $/ton | | | | *Economic Dispatch* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Category | Type | Generation (GWh) | Marg Cost ($/MWh) | CO2 Price Effect | Adj Price ($/MWh) | Adj Gen (GWh) | Gen Costs (M$) | *Generation (GWh)* | *Adj Price ($/MWh)* | *Gen Costs (M$)* |
| Dispatchable | Nat Gas | 93,562 | 80.0 | 16.6 | 96.6 | 105,931 | 10,232 | *93,562* | *96.6* | *9,037* |
| | Imp Hydro/Nuclear | 19,016 | 55.0 | 0.0 | 55.0 | 19,016 | 1,046 | *19,016* | *55.0* | *1,046* |
| | Imp Gas | 19,016 | 80.0 | 16.6 | 96.6 | 19,007 | 1,837 | *19,016* | *96.6* | *1,838* |
| | Imp Coal | 38,033 | 45.0 | 31.2 | 76.2 | 27,118 | 2,066 | *38,033* | *76.2* | *2,898* |
| | Oil & Other | 4,611 | 125.2 | 36.9 | 162.1 | 4,300 | 697 | *4,611* | *162.1* | *748* |
| | Coal | 2,145 | 30.0 | 46.8 | 76.8 | 1,012 | 78 | *2,145* | *76.8* | *165* |
| Fixed | Renewables | 23,648 | 55.0 | 0.0 | 55.0 | 23,648 | 1,301 | *23,648* | *55.0* | *1,301* |
| | Hydro | 39,632 | 30.0 | 0.0 | 30.0 | 39,632 | 1,189 | *39,632* | *30.0* | *1,189* |
| | Nuclear | 36,155 | 40.0 | 0.0 | 40.0 | 36,155 | 1,446 | *36,155* | *40.0* | *1,446* |
| | | 275,819 | | | | 275,819 | 19,892 | *275,819* | | *19,667* |

**Electricity from gas-fired plants costs more than from coal, but demand for gas-based electricity increases. This violates economic dispatch.**

*[Table copied from Synapse worksheet "Near Term" rows 59-69. Italics added by PG&E]*

# Flaws in Synapse Energy's Analysis (2)

- The Synapse model ignores increasing marginal costs of natural gas generation
- Synapse: In the Load-Based Cap scenario natural gas generation increases, but marginal costs do not
- Reality: As natural gas generation increases, less efficient units will come online, increasing the marginal cost (of natural gas generation)

Load-Based Cap Scenario

| Category | Type | Capacity (MW) | Generation (GWh) | Marg Cost ($/MWh) | CO2 Rate (Tons/MWh) | CO2 Price Effect | Adj Price ($/MWh) | Rel Price Change | Adj Gen (GWh) | CO2 Emis (kTons) | Gen Costs (M$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dispatchable | Nat Gas | 36,700 | 93,562 | 80.0 | 0.553 | 16.6 | 80.0 | | 105,931 | 58,577 | 8,474 |
| | Imp Hydro/Nuclear | 4,000 | 19,016 | 55.0 | 0 | 0.0 | 55.0 | | 19,016 | 0 | 1,046 |
| | Imp Gas | 4,000 | 19,016 | 80.0 | 0.555 | 16.6 | 80.0 | | 19,007 | 10,541 | 1,521 |
| | Imp Coal | 8,000 | 38,033 | 45.0 | 1.040 | 31.2 | 45.0 | | 27,118 | 28,203 | 1,220 |
| | Oil & Other | 1,031 | 4,611 | 125.2 | 1.230 | 36.9 | 125.2 | | 4,300 | 5,289 | 538 |
| | Coal | 389 | 2,145 | 30.0 | 1.560 | 46.8 | 30.0 | | 1,012 | 1,578 | 30 |
| Fixed | Renewables | 5,479 | 23,648 | 55.0 | 0 | 0.0 | 55.0 | | 23,648 | 0 | 1,301 |
| | Hydro | 10,088 | 39,632 | 30.0 | 0 | 0.0 | 30.0 | | 39,632 | 0 | 1,189 |
| | Nuclear | 4,324 | 36,155 | 40.0 | 0 | 0.0 | 40.0 | | 36,155 | 0 | 1,446 |
| | | 74,011 | 275,819 | | | | | | 275,819 | 104,188 | 16,766 |

Original Demand

Original Prices

Adjusted Demand has been copied from Source-Based scenario, but…

… Adjusted Prices do not change.

*[Table copied from Synapse worksheet "Near Term" rows 76-86. Captions added by SCE]*

# Flaws in Synapse Energy's Analysis (3)

- Instead of a market-clearing price, Synapse calculates a "weighted market price" as a weighted average of each dispatchable category's Generation times its "Marg Cost".

| Category | Type | Generation (GWh) | Marg Cost ($/MWh) |
|---|---|---|---|
| Dispatchable | Nat Gas | 93,562 | 80.0 |
| | Imp Hydro/Nuclear | 19,016 | 55.0 |
| | Imp Gas | 19,016 | 80.0 |
| | Imp Coal | 38,033 | 45.0 |
| | Oil & Other | 4,611 | 125.2 |
| | Coal | 2,145 | 30.0 |
| | Weighted Market Price ($/MWh) | | 70.33 |

*["Weighted Market Price" formula in Synapse worksheet "Near Term" cell Q26.]*

# Flaws in Synapse Energy's Analysis (4)

- Synapse analysis lacks a market-clearing price
- Synapse: Each category of dispatchable generators, including imports, is paid that category's "Marg Cost", not a market-clearing price.
- Reality: Low-emitting and high-emitting generators receive the same electricity price, both in today's WECC spot markets and in the future Integrated Forward Markets of the California Independent System Operator.

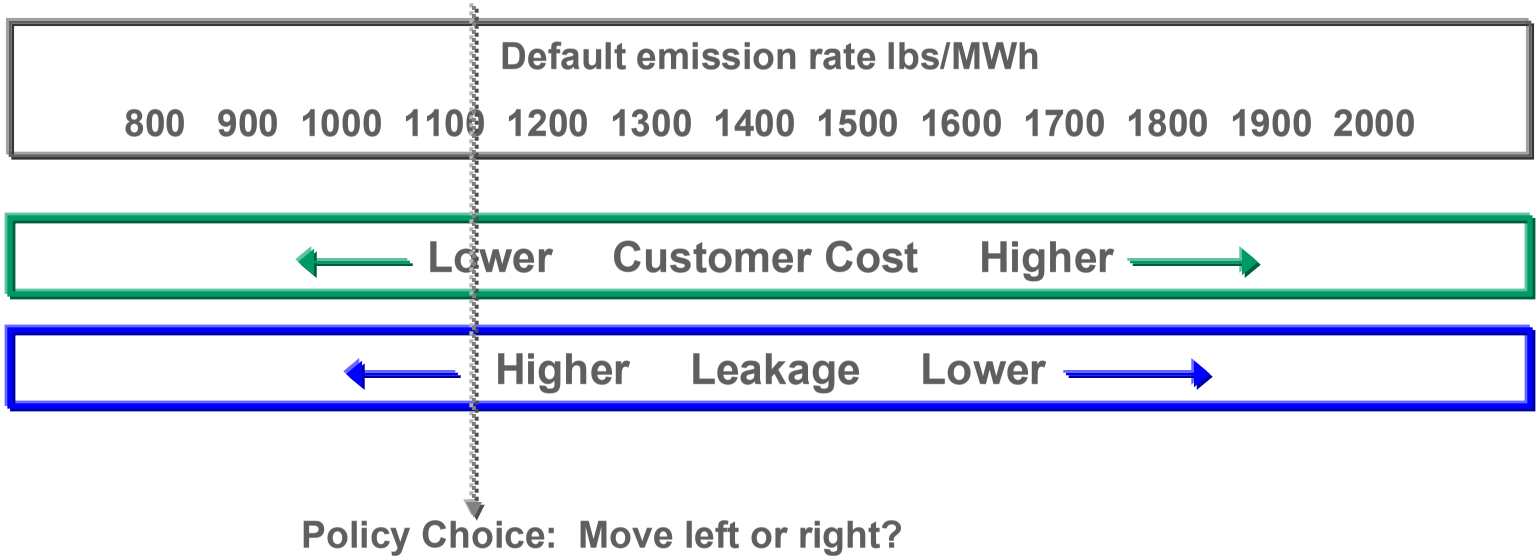
| Category | Type | Generation (GWh) | Marg Cost ($/MWh) | Gen Costs (M$) |
|---|---|---|---|---|
| Dispatchable | Nat Gas | 93,562 | 80.0 | 7,485 |
| | Imp Hydro/Nuclear | 19,016 | 55.0 | 1,046 |
| | Imp Gas | 19,016 | 80.0 | 1,521 |
| | Imp Coal | 38,033 | 45.0 | 1,711 |
| | Oil & Other | 4,611 | 125.2 | 577 |
| | Coal | 2,145 | 30.0 | 64 |

**Imp Gas Generation (19,016 GWh) * Imp Gas Marg Cost ($80/MWh) = Imp Gas Gen Costs ($1,521M)**

*[Table copied from Synapse worksheet "Near Term" rows 25-31.]*

# Impact of Default Emission Rate

- A default emission rate is needed for “unspecified” purchases (i.e., cannot be traced to a specific generator)
  - Under a Load-Based Cap, both imports and in-state purchases can come from unspecified sources
  - Under First-Seller only imports can come from unspecified resources
- A high default rate will increase customer costs: Low-emitters will have greater value to LSEs and will demand higher prices in negotiations
- A low default rate will increase leakage: More emissions from high-emitters will be lost



## CERTIFICATE OF SERVICE

I hereby certify that, pursuant to the Commission's Rules of Practice and Procedure, I have this day served a true copy of REPLY COMMENTS OF SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E) ON MODELING-RELATED ISSUES on all parties identified on the attached service list(s). Service was effected by one or more means indicated below:

> Transmitting the copies via e-mail to all parties who have provided an e-mail address. First class mail will be used if electronic service cannot be effectuated.

Executed this **18th of January 2008**, at Rosemead, California.

_/s/ Raquel Ippoliti_____
Raquel Ippoliti
Project Analyst
SOUTHERN CALIFORNIA EDISON COMPANY

2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770

CINDY ADAMS
COVANTA ENERGY CORPORATION
40 LANE ROAD
FAIRFIELD, NJ 7004
R.06-04-009

DAN ADLER
DIRECTOR, TECH AND POLICY DEVELOPMENT
CALIFORNIA CLEAN ENERGY FUND
5 THIRD STREET, SUITE 1125
SAN FRANCISCO, CA 94103
R.06-04-009

CASE ADMINISTRATION
SOUTHERN CALIFORNIA EDISON COMPANY
2244 WALNUT GROVE AVENUE, ROOM 370
ROSEMEAD, CA 91770
R.06-04-009

FARROKH ALBUYEH
VICE PRESIDENT
OPEN ACCESS TECHNOLOGY INTERNATIONAL INC
1875 SOUTH GRANT STREET
SAN MATEO, CA 94402
R.06-04-009

MICHAEL P. ALCANTAR
ATTORNEY AT LAW
ALCANTAR & KAHL LLP
1300 SW FIFTH AVENUE, SUITE 1750
PORTLAND, OR 97201
R.06-04-009

MAHLON ALDRIDGE
ECOLOGY ACTION
PO BOX 1188
SANTA CRUZ, CA 95060
R.06-04-009

KEN ALEX
1300 I STREET, SUITE 125
SACRAMENTO, CA 94244
R.06-04-009

CATHIE ALLEN
CA STATE MGR.
PACIFICORP
825 NE MULTNOMAH STREET, SUITE 2000
PORTLAND, OR 97232
R.06-04-009

PETER V. ALLEN
THELEN REID BROWN RAYSMAN & STEINER
101 SECOND STREET, SUITE 1800
SAN FRANCISCO, CA 94105
R.06-04-009

SCOTT J. ANDERS
RESEARCH/ADMINISTRATIVE CENTER
UNIVERSITY OF SAN DIEGO - LAW
5998 ALCALA PARK
SAN DIEGO, CA 92110
R.06-04-009

JASMIN ANSAR
PG&E
PO BOX 770000
SAN FRANCISCO, CA 94177
R.06-04-009

JEANNE B. ARMSTRONG
ATTORNEY AT LAW
GOODIN MACBRIDE SQUERI DAY & LAMPREY
505 SANSOME STREET, SUITE 900
SAN FRANCISCO, CA 94111
R.06-04-009

JESUS ARREDONDO
DIRECTOR, REGULATORY AND GOVERNMENTAL
NRG ENERGY, INC.
4600 CARLSBAD BLVD.
CARLSBAD, CA 99208
R.06-04-009

SAKIS ASTERIADIS
APX INC
1270 FIFTH AVE., SUITE 15R
NEW YORK, NY 10029
R.06-04-009

ELIZABETH BAKER
SUMMIT BLUE CONSULTING
1722 14TH STREET, SUITE 230
BOULDER, CO 80304
R.06-04-009

GARY BARCH
FELLON-MCCORD & ASSOCIATES, INC.
9960 CORPORATE CAMPUS DRIVE
LOUISVILLE, KY 40223
R.06-04-009

BARBARA R. BARKOVICH
BARKOVICH & YAP, INC.
44810 ROSEWOOD TERRACE
MENDOCINO, CA 95460
R.06-04-009

AIMEE BARNES
MANAGER REGULATORY AFFAIRS
ECOSECURITIES
206 W. BONITA AVENUE
CLAREMONT, CA 91711
R.06-04-009

CURT BARRY
717 K STREET, SUITE 503
SACRAMENTO, CA 95814
R.06-04-009

KELLY BARR
MANAGER, REGULATORY AFFAIRS & CONTRACTS
SALT RIVER PROJECT
PO BOX 52025, PAB 221
PHOENIX, AZ 85072-2025
R.06-04-009

OBADIAH BARTHOLOMY
MECHANICAL ENGINEER
SACRAMENTO MUNICIPAL UTILITY DISTRICT
6201 S. STREET
SACRAMENTO, CA 95817
R.06-04-009

PANAMA BARTHOLOMY
ADVISOR TO CHAIR PFANNENSTIEL
CALIFORNIA ENERGY COMMISSION
1516 9TH STREET
SACRAMENTO, CA 95814
R.06-04-009

CARMEN E. BASKETTE
SENIOR MGR MARKET DEVELOPMENT
ENERNOC
594 HOWARD ST., SUITE 400
SAN FRANCISCO, CA 94105
R.06-04-009

R. THOMAS BEACH
CROSSBORDER ENERGY
2560 NINTH STREET, SUITE 213A
BERKELEY, CA 94710-2557
R.06-04-009

SEAN P. BEATTY
ATTORNEY AT LAW
COOPER, WHITE & COOPER, LLP
201 CALIFORNIA ST., 17TH FLOOR
SAN FRANCISCO, CA 94111
R.06-04-009

BUD BEEBE
SACRAMENTO MUNICIPAL UTIL DIST
6201 S STREET
SACRAMENTO, CA 95817-1899
R.06-04-009

C. SUSIE BERLIN
ATTORNEY AT LAW
MCCARTHY & BERLIN, LLP
100 PARK CENTER PLAZA, SUITE 501
SAN JOSE, CA 95113
R.06-04-009

RYAN BERNARDO
BRAUN & BLAISING, P.C.
915 L STREET, SUITE 1270
SACRAMENTO, CA 95814
R.06-04-009

CLARK BERNIER
RLW ANALYTICS
1055 BROADWAY, SUITE G
SONOMA, CA 95476
R.06-04-009

SARAH BESERRA
CALIFORNIA REPORTS
39 CASTLE HILL COURT
VALLEJO, CA 94591
R.06-04-009

CLARENCE BINNINGER
DEPUTY ATTORNEY GENERAL
DEPARTMENT OF JUSTICE
455 GOLDEN GATE AVENUE,SUITE 11000
SAN FRANICSCO, CA 94102
R.06-04-009

CHARLIE BLAIR
DELTA ENERGY & ENVIRONMENT
15 GREAT STUART STREET
EDINBURGH, UK EH2 7TP
UNITED KINGDOM
R.06-04-009

B.B. BLEVINS
EXECUTIVE DIRECTOR
CALIFORNIA ENERGY COMMISSION
1516 9TH STREET, MS-39
SACRAMENTO, CA 95814
R.06-04-009

GREGORY T. BLUE
ENXCO DEVELOPMENT CORPORATION
5000 EXECUTIVE PARKWAY, STE.140
SAN RAMON, CA 94583
R.06-04-009

ASHLEE M. BONDS
THELEN REID BROWN RAYSMAN&STEINER LLP
101 SECOND STREET
SAN FRANCISCO, CA 94105
R.06-04-009

WILLIAM H. BOOTH
ATTORNEY AT LAW
LAW OFFICE OF WILLIAM H. BOOTH
1500 NEWELL AVE., 5TH FLOOR
WALNUT CREEK, CA 94556
R.06-04-009

KEVIN BOUDREAUX
CALPINE POWER AMERICA-CA, LLC
717 TEXAS AVENUE, SUITE 1000
HOUSTON, TX 77002
R.06-04-009

KYLE D. BOUDREAUX
FPL GROUP
700 UNIVERSE BLVD., JES/JB
JUNO BEACH, FL 33408
R.06-04-009

KAREN BOWEN
ATTORNEY AT LAW
WINSTON & STRAWN LLP
101 CALIFORNIA STREET
SAN FRANCISCO, CA 94111
R.06-04-009

BIANCA BOWMAN
RATE CASE COORDINATOR
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000 MCB9A
SAN FRANCISCO, CA 94177
R.06-04-009

ANDREW BRADFORD
SENIOR MARKET RESEARCH ASSOCIATE
FELLON-MCCORD & ASSOCIATES
9960 CORPORATE CAMPUS DRIVE
LOUISVILLE, KY 40223
R.06-04-009

DAVID BRANCHCOMB
BRANCHCOMB ASSOCIATES, LLC
9360 OAKTREE LANE
ORANGEVILLE, CA 95662
R.06-04-009

DOWNEY BRAND
DOWNEY BRAND
555 CAPITOL MALL, 10TH FLOOR
SACRAMENTO, CA 95814-4686
R.06-04-009

CLARE BREIDENICH
224 1/2 24TH AVENUE EAST
SEATTLE, WA 98112
R.06-04-009

ADAM BRIONES
THE GREENLINING INSTITUTE
1918 UNIVERSITY AVENUE, 2ND FLOOR
BERKELEY, CA 94704
R.06-04-009

GLORIA BRITTON
ANZA ELECTRIC COOPERATIVE, INC.
PO BOX 391909
ANZA, CA 92539
R.06-04-009

DONALD BROOKHYSER
ATTORNEY AT LAW
ALCANTAR & KAHL LLP
1300 S.W. 5TH AVENUE, SUITE 1750
PORTLAND, OR 97201
R.06-04-009

DONALD BROOKHYSER
ATTORNEY AT LAW
ALCANTAR & KAHL
120 MONTGOMERY STREET
SAN FRANCISCO, CA 94104
R.06-04-009

DOUGLAS BROOKS
NEVADA POWER COMPANY
SIERRA PACIFIC POWER COMPANY
6226 WEST SAHARA AVENUE
LAS VEGAS, NV 89151
R.06-04-009

ANDREW B. BROWN
ATTORNEY AT LAW
ELLISON, SCHNEIDER & HARRIS, LLP
2015 H STREET
SACRAMENTO, CA 95814
R.06-04-009

VERONIQUE BUGNION
POINT CARBON
205 SEVERN RIVER RD
SEVERNA PARK, MD 21146
R.06-04-009

JACK BURKE
LEGISLATIVE AFFAIRS MANAGER
CALIFORNIA CENTER FOR SUSTAINABLE ENERGY
8690 BALBOA AVE., SUITE 100
SAN DIEGO, CA 92123
R.06-04-009

THERESA BURKE
SAN FRANCISCO PUC
1155 MARKET STREET, 4TH FLOOR
SAN FRANCISO, CA 94103
R.06-04-009

PAM BURMICH
AIR RESOURCES BOAD
1001 I STREET, BOX 2815
SACRAMENTO, CA 95812
R.06-04-009

DALLAS BURTRAW
1616 P STREET, NW
WASHINGTON, DC 20036
R.06-04-009

JOSHUA BUSHINSKY
WESTERN POLICY COORDINATOR
PEW CENTER ON GLOBAL CLIMATE CHANGE
2101 WILSON BLVD., SUITE 550
ARLINGTON, VA 95816
R.06-04-009

OLOF BYSTROM
DIRECTOR, WESTERN ENERGY
CAMBRIDGE ENERGY RESEARCH ASSOCIATES
555 CALIFORNIA STREET, 3RD FLOOR
SAN FRANCISCO, CA 94104
R.06-04-009

Eugene Cadenasso
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Andrew Campbell
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5304
SAN FRANCISCO, CA 94102-3214
R.06-04-009

TRENT A CARLSON
RELIANT ENERGY
1000 MAIN STREET
HOUSTON, TX 77001
R.06-04-009

SANDRA CAROLINA
SOUTHWEST GAS CORPORATION
PO BOX 98510
LAS VEGAS, NV 89193-8510
R.06-04-009

IAN CARTER
INTERNATIONAL EMISSIONS TRADING ASSN.
350 SPARKS STREET, STE. 809
OTTAWA, ON K1R 7S8
CANADA
R.06-04-009

SHERYL CARTER
NATURAL RESOURCES DEFENSE COUNCIL
111 SUTTER STREET, 20TH FLOOR
SAN FRANCISCO, CA 94104
R.06-04-009

PHIL CARVER
OREGON DEPARTMENT OF ENERGY
625 MARION ST., NE
SALEM, OR 97301-3737
R.06-04-009

Bishu Chatterjee
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 3-E
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Theresa Cho
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5207
SAN FRANCISCO, CA 94102-3214
R.06-04-009

JENNIFER CHAMBERLIN
STRATEGIC ENERGY, LLC
2633 WELLINGTON CT.
CLYDE, CA 94520
R.06-04-009

AUDREY CHANG
NATURAL RESOURCES DEFENSE COUNCIL
111 SUTTER STREET, 20TH FLOOR
SAN FRANCISCO, CA 94104
R.06-04-009

CLIFF CHEN
UNION OF CONCERNED SCIENTISTS
2397 SHATTUCK AVENUE, SUITE 203
BERKELEY, CA 94704
R.06-04-009

WILLIAM H. CHEN
DIRECTOR, ENERGY POLICY WEST REGION
CONSTELLATION NEW ENERGY, INC.
ONE MARKET STREET
SAN FRANCISCO, CA 94105
R.06-04-009

BRIAN K. CHERRY
VICE PRESIDENT, REGULATORY RELATIONS
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000, MAIL CODE: B10C
SAN FRANCISCO, CA 94177
R.06-04-009

ED CHIANG
ELEMENT MARKETS, LLC
ONE SUGAR CREEK CENTER BLVD., SUITE 250
SUGAR LAND, TX 77478
R.06-04-009

STEVEN M. COHN
ASSISTANT GENERAL COUNSEL
SACRAMENTO MUNICIPAL UTILITY DISTRICT
PO BOX 15830
SACRAMENTO, CA 95852-1830
R.06-04-009

KENNETH A. COLBURN
SYMBILTIC STRATEGIES, LLC
26 WINTON ROAD
MEREDITH, NH 3253
R.06-04-009

GARY COLLORD
STATIONARY SOURCE DIVISION
AIR RESOURCES BOARD
1001 I STREET, PO BOX 2815
SACRAMENTO, CA 95812
R.06-04-009

ALAN COMNES
WEST COAST POWER
3934 SE ASH STREET
PORTLAND, OR 97214
R.06-04-009

LISA A. COTTLE
ATTORNEY AT LAW
WINSTON & STRAWN, LLP
101 CALIFORNIA STREET, 39TH FLOOR
SAN FRANCISCO, CA 94111
R.06-04-009

RICHARD COWART
REGULATORY ASSISTANCE PROJECT
50 STATE STREET, SUITE 3
MONTPELIER, VT 5602
R.06-04-009

BRIAN T. CRAGG
ATTORNEY AT LAW
GOODIN MACBRIDE SQUERI RITCHIE & DAY
505 SANSOME STREET, SUITE 900
SAN FRANCISCO, CA 94111
R.06-04-009

HOLLY B. CRONIN
STATE WATER PROJECT OPERATIONS DIV
CALIFORNIA DEPARTMENT OF WATER RESOURCES
3310 EL CAMINO AVE., LL-90
SACRAMENTO, CA 95821
R.06-04-009

SEBASTIEN CSAPO
PROJECT MANAGER
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000
SAN FRANCISCO, CA 94177
R.06-04-009

RAYMOND J. CZAHAR, C.P.A.
CHIEF FINANCIAL OFFICER
WEST COAST GAS COMPANY
9203 BEATTY DRIVE
SACRAMENTO, CA 95826
R.06-04-009

KARLA DAILEY
CITY OF PALO ALTO
BOX 10250
PALO ALTO, CA 94303
R.06-04-009

THOMAS DARTON
PILOT POWER GROUP, INC.
8910 UNIVERSITY CENTER LANE
SAN DIEGO, CA 92122
R.06-04-009

KYLE L. DAVIS
PACIFICORP
825 NE MULTNOMAH ST., SUITE 2000
PORTLAND, OR 97232
R.06-04-009

Matthew Deal
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5215
SAN FRANCISCO, CA 94102-3214
R.06-04-009

RONALD F. DEATON
LOS ANGELES DEPARTMENT OF WATER & POWER
111 NORTH HOPE STREET, ROOM 1550
LOS ANGELES, CA 90012
R.06-04-009

LISA DECARLO
STAFF COUNSEL
CALIFORNIA ENERGY COMMISSION
1516 9TH STREET MS-14
SACRAMENTO, CA 95814
R.06-04-009

PAUL DELANEY
AMERICAN UTILITY NETWORK (A.U.N.)
10705 DEER CANYON DRIVE
ALTA LOMA, CA 91737
R.06-04-009

RALPH E. DENNIS
DIRECTOR, REGULATORY AFFAIRS
FELLON-MCCORD & ASSOCIATES
9960 CORPORATE CAMPUS DRIVE, STE 2000
LOUISVILLE, KY 40223
R.06-04-009

LEONARD DEVANNA
EXECUTIVE VICE PRESIDENT
CLEAN ENERGY SYSTEMS, INC.
11330 SUNCO DRIVE, SUITE A
RANCHO CORDOVA, CA 95742
R.06-04-009

BALDASSARO DI CAPO
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

WILLIAM F. DIETRICH
ATTORNEY AT LAW
DIETRICH LAW
2977 YGNACIO VALLEY ROAD, 613
WALNUT CREEK, CA 94598-3535
R.06-04-009

TREVOR DILLARD
SIERRA PACIFIC POWER COMPANY
6100 NEIL ROAD, MS S4A50
RENO, NV 89520
R.06-04-009

THOMAS DILL
PRESIDENT
LODI GAS STORAGE, LLC
1021 MAIN ST STE 1500
HOUSTON, TX 77002-6509
R.06-04-009

JEFFREY DOLL
CALIFORNIA AIR RESOURCES BOARD
PO BOX 2815 1001 I STREET
SACRAMENTO, CA 95812
R.06-04-009

DANIEL W. DOUGLASS
ATTORNEY AT LAW
DOUGLASS & LIDDELL
21700 OXNARD STREET, SUITE 1030
WOODLAND HILLS, CA 91367
R.06-04-009

JASON DUBCHAK
ASSOCIATE GENERAL COUNSEL
WILD GOOSE STORAGE, LLC
607 8TH AVENUE S.W.
CALGARY, AB T2P OA7
CANADA
R.06-04-009

KIRBY DUSEL
NAVIGANT CONSULTING, INC.
3100 ZINFANDEL DRIVE, SUITE 600
RANCHO CORDOVA, CA 95670
R.06-04-009

PIERRE H. DUVAIR
CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET, MS-41
SACRAMENTO, CA 95814
R.06-04-009

HARVEY EDER
PUBLIC SOLAR POWER COALITION
1218 12TH ST., 25
SANTA MONICA, CA 90401
R.06-04-009

DENNIS M.P. EHLING
KIRKPATRICK & LOCKHART NICHOLSON GRAHAM
10100 SANTA MONICA BLVD., 7TH FLOOR
LOS ANGELES, CA 90067
R.06-04-009

THOMAS ELGIE
POWEREX CORPORATION
1400, 666 BURRAND ST
VANCOUVER, BC V6C 2X8
CANADA
R.06-04-009

SHAUN ELLIS
2183 UNION STREET
SAN FRANCISCO, CA 94123
R.06-04-009

SANDRA ELY
NEW MEXICO ENVIRONMENT DEPARTMENT
1190 ST FRANCIS DRIVE
SANTA FE, NM 87501
R.06-04-009

NADAV ENBAR
ENERGY INSIGHTS
1750 14TH STREET, SUITE 200
BOULDER, CO 80302
R.06-04-009

STEVE ENDO
PASADENA DEPARTMENT OF WATER & POWER
45 EAST GLENARM STREET
PASADENA, CA 91105
R.06-04-009

SAEED FARROKHPAY
FEDERAL ENERGY REGULATORY COMMISSION
110 BLUE RAVINE RD., SUITE 107
FOLSOM, CA 95630
R.06-04-009

DIANE I. FELLMAN
ATTORNEY AT LAW
LAW OFFICES OF DIANE I. FELLMAN
234 VAN NESS AVENUE
SAN FRANCISCO, CA 94102
R.06-04-009

Julie A. Fitch
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5119
SAN FRANCISCO, CA 94102-3214
R.06-04-009

MICHEL PETER FLORIO
ATTORNEY AT LAW
THE UTILITY REFORM NETWORK (TURN)
711 VAN NESS AVENUE, SUITE 350
SAN FRANCISCO, CA 94102
R.06-04-009

RYAN FLYNN
PACIFICORP
825 NE MULTNOMAH STREET, 18TH FLOOR
PORTLAND, OR 97232
R.06-04-009

Cathleen A. Fogel
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Jamie Fordyce
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 5-B
SAN FRANCISCO, CA 94102-3214
R.06-04-009

CYNTHIA A. FONNER
SENIOR COUNSEL
CONSTELLATION ENERGY GROUP INC
550 W. WASHINGTON ST, STE 300
CHICAGO, IL 60661
R.06-04-009

ORLANDO B. FOOTE, III
ATTORNEY AT LAW
HORTON, KNOX, CARTER & FOOTE
895 BROADWAY, SUITE 101
EL CENTRO, CA 92243
R.06-04-009

JONATHAN FORRESTER
PG&E
PO BOX 770000
SAN FRANCISCO, CA 94177
R.06-04-009

KEVIN FOX
WILSON SONSINI GOODRICH & ROSATI
ONE MARKET STREET, SPEAR TOWER,
3300
SAN FRANCISCO, CA 94105
R.06-04-009

NORMAN J. FURUTA
ATTORNEY AT LAW
FEDERAL EXECUTIVE AGENCIES
1455 MARKET ST., SUITE 1744
SAN FRANCISCO, CA 94103-1399
R.06-04-009

MICHELLE GARCIA
AIR RESOURCES BOARD
1001 10TH STREET
SACRAMENTO, CA 95814
R.06-04-009

LAURA GENAO
ATTORNEY AT LAW
SOUTHERN CALIFORNIA EDISON COMPANY
2244 WALNUT GROVE AVENUE
ROSEMEAD, CA 91770
R.06-04-009

FIJI GEORGE
EL PASO CORPORATION
PO BOX 2511
HOUSTON, TX 77252
R.06-04-009

Anne Gillette
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

MELANIE GILLETTE
DUKE ENERGY NORTH AMERICA
980 NINTH STREET, SUITE 1420
SACRAMENTO, CA 95814
R.06-04-009

ANNETTE GILLIAM
SCE LAW DEPARTMENT
SOUTHERN CALIFORNIA EDISON COMPANY
2244 WALNUT GROVE AVENUE
ROSEMEAD, CA 91770
R.06-04-009

JULIE GILL
EXTERNAL AFFAIRS MANAGER
CALIFORNIA INDEPENDENT SYSTEM
OPERATOR
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

HOWARD V. GOLUB
NIXON PEABODY LLP
2 EMBARCADERO CENTER, STE. 2700
SAN FRANCISCO, CA 94111
R.06-04-009

HAYLEY GOODSON
ATTORNEY AT LAW
THE UTILITY REFORM NETWORK
711 VAN NESS AVENUE, SUITE 350
SAN FRANCISCO, CA 94102
R.06-04-009

JAIRAM GOPAL
SOUTHERN CALIFORNIA EDISON
2244 WALNUT GROVE, GO1-C
ROSEMEAD, CA 91770
R.06-04-009

KASSANDRA GOUGH
CALPINE CORPORATION
1127 11TH STREET, SUITE 242
SACRAMENTO, CA 95814
R.06-04-009

Jacqueline Greig
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4102
SAN FRANCISCO, CA 94102-3214
R.06-04-009

JEFFREY P. GRAY
ATTORNEY AT LAW
DAVIS WRIGHT TREMAINE, LLP
505 MONTGOMERY STREET, SUITE 800
SAN FRANCISCO, CA 94111-6533
R.06-04-009

JOSEPH GRECO
VICE PRESIDENT - WESTERN REGION
CAITHNESS ENERGY, LLC.
9590 PROTOTYPE COURT, SUITE 200
RENO, NV 89521
R.06-04-009

KRISTIN GRENFELL
PROJECT ATTORNEY, CALIF. ENERGY PROGRAM
NATURAL RESOURCES DEFENSE COUNCIL
111 SUTTER STREET, 20TH FLOOR
SAN FRANCISCO, CA 94104
R.06-04-009

KAREN GRIFFIN
EXECUTIVE OFFICE
CALIFORNIA ENERGY COMMISSION
1516 9TH STREET, MS 39
SACRAMENTO, CA 95814
R.06-04-009

ANN G. GRIMALDI
MCKENNA LONG & ALDRIDGE LLP
101 CALIFORNIA STREET, 41ST FLOOR
Center for Energy and Economic Development
SAN FRANCISCO, CA 94111
R.06-04-009

YVONNE GROSS
REGULATORY POLICY MANAGER
SEMPRA ENERGY
101 ASH STREET
SAN DIEGO, CA 92103
R.06-04-009

ELSTON K. GRUBAUGH
IMPERIAL IRRIGATION DISTRICT
333 EAST BARIONI BLVD.
IMPERIAL, CA 92251
R.06-04-009

ELIZABETH W. HADLEY
CITY OF REDDING
777 CYPRESS AVENUE
REDDING, CA 96001
R.06-04-009

JEFFREY L. HAHN
COVANTA ENERGY CORPORATION
876 MT. VIEW DRIVE
LAFAYETTE, CA 94549
R.06-04-009

TOM HAMILTON
MANAGING PARTNER
ENERGY CONCIERGE SERVICES
321 MESA LILA RD
GLENDALE, CA 91208
R.06-04-009

PETER W. HANSCHEN
ATTORNEY AT LAW
MORRISON & FOERSTER, LLP
101 YGNACIO VALLEY ROAD, SUITE 450
WALNUT CREEK, CA 94596
R.06-04-009

ANDREW L. HARRIS
PACIFIC GAS & ELECTRIC COMPANY
PO BOX 770000 MAIL CODE B9A
SAN FRANCISCO, CA 94177
R.06-04-009

ARNO HARRIS
RECURRENT ENERGY, INC.
1700 MONTGOMERY ST., SUITE 251
SAN FRANCISCO, CA 94111
R.06-04-009

JEFFERY D. HARRIS
ATTORNEY AT LAW
ELLISON, SCHNEIDER & HARRIS LLP
2015 H STREET
SACRAMENTO, CA 95814
R.06-04-009

AUDRA HARTMANN
DYNEGY, INC.
980 NINTH STREET, SUITE 2130
SACRAMENTO, CA 95814
R.06-04-009

ANITA HART
SENIOR SPECIALIST/STATE
REGULATORYAFFAIR
SOUTHWEST GAS CORPORATION
5241 SPRING MOUNTAIN ROAD
LAS VEGAS, NV 89193
R.06-04-009

KERRY HATTEVIK
MIRANT CORPORATION
696 WEST 10TH STREET
PITTSBURG, CA 94565
R.06-04-009

LYNN HAUG
ELLISON, SCHNEIDER & HARRIS, LLP
2015 H STREET
SACRAMENTO, CA 95814-3109
R.06-04-009

MARCEL HAWIGER
ATTORNEY AT LAW
THE UTILITY REFORM NETWORK
711 VAN NESS AVENUE, SUITE 350
SAN FRANCISCO, CA 94102
R.06-04-009

DAN HECHT
SEMPRA ENERGY
101 ASH STREET
SAN DIEGO, CA 92101
R.06-04-009

RICHARD HELGESON
SOUTHERN CALIFORNIA PUBLIC POWER
AUTHORI
225 S. LAKE AVE., SUITE 1250
PASADENA, CA 91101
R.06-04-009

UDI HELMAN
CALIFORNIA INDEPENDENT SYS. OPER.
CORP
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

TIM HEMIG
DIRECTOR
NRG ENERGY, INC.
1819 ASTON AVENUE, SUITE 105
CARLSBAD, CA 92008
R.06-04-009

JOSEPH HENRI
31 MIRAMONTE ROAD
WALNUT CREEK, CA 94597
R.06-04-009

CHRISTOPHER A. HILEN
ASSISTANT GENERAL COUNSEL
SIERRA PACIFIC POWER COMPANY
6100 NEIL ROAD
RENO, NV 89511
R.06-04-009

SETH HILTON
ATTORNEY AT LAW
STOEL RIVES
111 SUTTER ST., SUITE 700
SAN FRANCISCO, CA 94104
R.06-04-009

GARY HINNERS
RELIANT ENERGY, INC.
PO BOX 148
HOUSTON, TX 77001-0148
R.06-04-009

ALDYN HOEKSTRA
PACE GLOBAL ENERGY SERVICES
420 WEST BROADWAY, 4TH FLOOR
SAN DIEGO, CA 92101
R.06-04-009

J. ANDREW HOERNER
REDEFINING PROGRESS
1904 FRANKLIN STREET
OAKLAND, CA 94612
R.06-04-009

LAURIE TEN HOPE
ADVISOR TO COMMISSIONER BYRON
CALIFORNIA ENERGY COMMISSION
1516 9TH STREET, MS-32
SACRAMENTO, CA 95814-5512
R.06-04-009

GEORGE HOPLEY
BARCLAYS CAPITAL
200 PARK AVENUE
NEW YORK, NY 10166
R.06-04-009

RANDY S. HOWARD
LOS ANGELES DEPT. OF WATER AND POWER
111 NORTH HOPE STREET, ROOM 921
LOS ANGELES, CA 90012
R.06-04-009

DAVID L.. HUARD
ATTORNEY AT LAW
MANATT PHELPS & PHILLIPS LLP
11355 WEST OLYMPIC BOULEVARD
LOS ANGELES, CA 90064
R.06-04-009

JOHN P HUGHES
MANAGER, REGULATORY AFFAIRS
SOUTHERN CALIFORNIA EDISON COMPANY
601 VAN NESS AVENUE, STE. 2040
SAN FRANCISCO, CA 94102
R.06-04-009

STEVEN HUHMAN
MORGAN STANLEY CAPITAL GROUP INC.
2000 WESTCHESTER AVENUE
PURCHASE, NY 10577
R.06-04-009

RAYMOND HUNG
PG&E
PO BOX 770000 MAIL CODE B9A
SAN FRANCISCO, CA 94177
R.06-04-009

TAMLYN M. HUNT
ENERGY PROGRAM DIRECTOR
COMMUNITY ENVIRONMENTAL COUNCIL
26 W. ANAPAMU ST., 2ND FLOOR
SANTA BARBARA, CA 93101
R.06-04-009

CAROL J. HURLOCK
CALIFORNIA DEPT. OF WATER RESOURCES
3310 EL CAMINO AVE. RM 300
SACRAMENTO, CA 95821
R.06-04-009

MICHAEL A. HYAMS
POWER ENTERPRISE-REGULATORY AFFAIRS
SAN FRANCISCO PUBLIC UTILITIES COMM
1155 MARKET ST., 4TH FLOOR
SAN FRANCISCO, CA 94103
R.06-04-009

Judith Ikle
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4012
SAN FRANCISCO, CA 94102-3214
R.06-04-009

AKBAR JAZAYEIRI
DIRECTOR OF REVENUE & TARRIFFS
SOUTHERN CALIFORNIA EDISON COMPANY
2244 WALNUT GROVE AVE. ROOM 390
ROSEMEAD, CA 91770
R.06-04-009

PETER JAZAYERI
STROOCK & STROOCK & LAVAN LLP
2029 CENTURY PARK EAST, SUITE 1800
LOS ANGELES, CA 90067
R.06-04-009

BRUNO JEIDER
BURBANK WATER AND POWER
164 WEST MAGNOLIA BOULEVARD
BURBANK, CA 91502
R.06-04-009

JOHN JENSEN
PRESIDENT
MOUNTAIN UTILITIES
PO BOX. 205
KIRKWOOD, CA 95646
R.06-04-009

LEILANI JOHNSON KOWAL
LOS ANGELES DEPT. OF WATER AND POWER
111 N. HOPE STREET, ROOM 1050
LOS ANGELES, CA 90012
R.06-04-009

KENNETH C. JOHNSON
KENNETH CARLISLE JOHNSON
2502 ROBERTSON RD
SANTA CLARA, CA 95051
R.06-04-009

BRIAN M. JONES
M.J. BRADLEY & ASSOCIATES, INC.
47 JUNCTION SQUARE DRIVE
CONCORD, MA 1742
R.06-04-009

MARC D. JOSEPH
ATTORNEY AT LAW
ADAMS, BROADWELL, JOSEPH & CARDOZO
601 GATEWAY BLVD., STE. 1000
SOUTH SAN FRANCISCO, CA 94080
R.06-04-009

Sara M. Kamins
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

EVELYN KAHL
ATTORNEY AT LAW
ALCANTAR & KAHL, LLP
120 MONTGOMERY STREET, SUITE 2200
SAN FRANCISCO, CA 94104
R.06-04-009

CATHY A. KARLSTAD
SOUTHERN CALIFORNIA EDISON COMPANY
2244 WALNUT GROVE AVE.
ROSEMEAD, CA 91770
R.06-04-009

JOSEPH M. KARP
ATTORNEY AT LAW
WINSTON & STRAWN LLP
101 CALIFORNIA STREET
SAN FRANCISCO, CA 94111-5802
R.06-04-009

SUE KATELEY
EXECUTIVE DIRECTOR
CALIFORNIA SOLAR ENERGY INDUSTRIES ASSN
PO BOX 782
RIO VISTA, CA 94571
R.06-04-009

ADAM J KATZ
MCDERMOTT WILL & EMERY LLP
600 13TH STREET, NW
WASHINGTON, DC 20005
R.06-04-009

JAMES W. KEATING
BP AMERICA, INC.
150 W. WARRENVILLE RD.
NAPERVILLE, IL 60563
R.06-04-009

CURTIS KEBLER
GOLDMAN, SACHS & CO.
2121 AVENUE OF THE STARS
LOS ANGELES, CA 90067
R.06-04-009

RANDALL W. KEEN
ATTORNEY AT LAW
MANATT PHELPS & PHILLIPS, LLP
11355 WEST OLYMPIC BLVD.
LOS ANGELES, CA 90064
R.06-04-009

CAROLYN M. KEHREIN
ENERGY MANAGEMENT SERVICES
1505 DUNLAP COURT
DIXON, CA 95620-4208
R.06-04-009

ALEXIA C KELLY
THE CLIMATE TRUST
65 SW YAMHILL STREET, SUITE 400
PORTLAND, OR 97204
R.06-04-009

STEVEN KELLY
INDEPENDENT ENERGY PRODUCERS
1215 K STREET, SUITE 900
SACRAMENTO, CA 95814
R.06-04-009

DOUGLAS K. KERNER
ATTORNEY AT LAW
ELLISON, SCHNEIDER & HARRIS LLP
2015 H STREET
SACRAMENTO, CA 95814
R.06-04-009

KHURSHID KHOJA
ASSOCIATE
THELEN REID BROWN RAYSMAN & STEINER
101 SECOND STREET, SUITE 1800
SAN FRANCISCO, CA 94105
R.06-04-009

KIM KIENER
504 CATALINA BLVD.
SAN DIEGO, CA 92106
R.06-04-009

THOMAS S KIMBALL
MODESTO IRRIGATION DISTRICT
1231 11TH STREET
MODESTO, CA 95354
R.06-04-009

DANIEL A. KING
SEMPRA ENERGY
101 ASH STREET, HQ 12
SAN DIEGO, CA 92101
R.06-04-009

GREGORY KLATT
ATTORNEY AT LAW
DOUGLASS & LIDDELL
411 E. HUNTINGTON DRIVE, SUITE 107-356
ARCADIA, CA 91007
R.06-04-009

JOSEPH KLOBERDANZ
SAN DIEGO GAS & ELECTRIC COMPANY
8330 CENTURY PARK COURT
SAN DIEGO, CA 92123
R.06-04-009

STEPHEN G. KOERNER, ESQ.
EL PASO CORPORATION
2 NORTH NEVADA AVENUE
COLORADO SPRINGS, CO 80903
R.06-04-009

GREGORY KOISER
CONSTELLATION NEW ENERGY, INC.
350 SOUTH GRAND AVENUE, SUITE 3800
LOS ANGELES, CA 90071
R.06-04-009

AVIS KOWALEWSKI
CALPINE CORPORATION
3875 HOPYARD ROAD, SUITE 345
PLEASANTON, CA 94588
R.06-04-009

STEVE KROMER
3110 COLLEGE AVENUE, APT 12
BERKELEY, CA 94705
R.06-04-009

CATHERINE M KRUPKA
MCDERMOTT WILL AND EMERY LLP
600 THIRTEEN STREEET, NW
WASHINGTON, DC 20005
R.06-04-009

LARS KVALE
CENTER FOR RESOURCE SOLUTIONS
PO BOX 39512
SAN FRANCISCO, CA 94129
R.06-04-009

Jonathan Lakritz
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5020
SAN FRANCISCO, CA 94102-3214
R.06-04-009

STEPHAINE LA SHAWN
PG&E
PO BOX 770000
SAN FRANCISCO, CA 94177
R.06-04-009

GERALD LAHR
ABAG PUBLICLY OWNED ENERGY RESOURCES
101 8TH STREET (P.O. BOX 2050)
OAKLAND, CA 94607
R.06-04-009

MIKE LAMOND
ALPINE NATURAL GAS OPERATING CO. #1 LLC
PO BOX 550
VALLEY SPRINGS, CA 95252
R.06-04-009

JOHN LAUN
APOGEE INTERACTIVE, INC.
1220 ROSECRANS ST., SUITE 308
SAN DIEGO, CA 92106
R.06-04-009

Diana L. Lee
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4300
SAN FRANCISCO, CA 94102-3214
R.06-04-009

VITALY LEE
AES ALAMITOS, LLC
690 N. STUDEBAKER ROAD
LONG BEACH, CA 90803
R.06-04-009

BRENDA LEMAY
DIRECTOR
HORIZON WIND ENERGY
1600 SHATTUCK, SUITE 222
BERKELEY, CA 94709
R.06-04-009

NICHOLAS LENSSEN
ENERGY INSIGHTS
1750 14TH STREET, SUITE 200
BOULDER, CO 80302
R.06-04-009

JOHN W. LESLIE, ESQ.
ATTORNEY AT LAW
LUCE, FORWARD, HAMILTON & SCRIPPS, LLP
11988 EL CAMINO REAL, SUITE 200
SAN DIEGO, CA 92130
R.06-04-009

DONALD C. LIDDELL P. C.
DOUGLASS & LIDDELL
2928 2ND AVENUE
SAN DIEGO, CA 92103
R.06-04-009

KAREN LINDH
CALIFORNIA ONSITE GENERATION
7909 WALERGA ROAD, NO. 112, PMB119
ANTELOPE, CA 95843
R.06-04-009

STEVEN G. LINS
GENERAL COUNSEL
GLENDALE WATER AND POWER
613 EAST BROADWAY, SUITE 220
GLENDALE, CA 91206-4394
R.06-04-009

STEVEN A. LIPMAN
STEVEN LIPMAN CONSULTING
500 N. STREET 1108
SACRAMENTO, CA 95814
R.06-04-009

GRACE LIVINGSTON-NUNLEY
ASSISTANT PROJECT MANAGER
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000 MAIL CODE B9A
SAN FRANCISCO, CA 94177
R.06-04-009

BILL LOCKYER
STATE ATTORNEY GENERAL
STATE OF CALIFORNIA, DEPT OF JUSTICE
PO BOX 944255
SACRAMENTO, CA 94244-2550
R.06-04-009

JODY S. LONDON
JODY LONDON CONSULTING
PO BOX 3629
OAKLAND, CA 94609
R.06-04-009

LAD LORENZ
V.P. REGULATORY AFFAIRS
SEMPRA UTILITIES
601 VAN NESS AVENUE, SUITE 2060
SAN FRANCISCO, CA 94102
R.06-04-009

BARRY LOVELL
15708 POMERADO RD., SUITE 203
POWAY, CA 92064
R.06-04-009

BOB LUCAS
LUCAS ADVOCATES
1121 L STREET, SUITE 407
SACRAMENTO, CA 95814
R.06-04-009

ED LUCHA
CASE COORDINATOR
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000, MAIL CODE B9A
SAN FRANCISCO, CA 94177
R.06-04-009

JANE E. LUCKHARDT
ATTORNEY AT LAW
DOWNEY BRAND LLP
555 CAPITOL MALL, 10TH FLOOR
SACRAMENTO, CA 95814
R.06-04-009

LYNELLE LUND
COMMERCE ENERGY, INC.
600 ANTON BLVD., SUITE 2000
COSTA MESA, CA 92626
R.06-04-009

MARY LYNCH
VP - REGULATORY AND LEGISLATIVE AFFAIRS
CONSTELLATION ENERGY COMMODITIES GROUP
2377 GOLD MEDAL WAY, SUITE 100
GOLD RIVER, CA 95670
R.06-04-009

Jaclyn Marks
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5306
SAN FRANCISCO, CA 94102-3214
R.06-04-009

DOUGLAS MACMULLLEN
CHIEF, POWER PLANNING SECTION
CA DEPARTMENT OF WATER RESOURCES
3310 EL CAMINO AVE., ROOM 356
SACRAMENTO, CA 95821
R.06-04-009

AMBER MAHONE
ENERGY & ENVIRONMENTAL ECONOMICS, INC.
101 MONTGOMERY STREET, SUITE 1600
SAN FRANCISCO, CA 94104
R.06-04-009

ANNABELLE MALINS
CONSUL-SCIENCE AND TECHNOLOGY
BRITISH CONSULATE-GENERAL
ONE SANSOME STREET, SUITE 850
SAN FRANCISCO, CA 94104
R.06-04-009

DEREK MARKOLF
CALIFORNIA CLIMATE ACTION REGISTRY
515 S. FLOWER STREET, SUITE 1640
LOS ANGELES, CA 90071
R.06-04-009

CHRIS MARNAY
1 CYCLOTRON RD MS 90R4000
BERKELEY, CA 94720-8136
R.06-04-009

JULIE L. MARTIN
WEST ISO COORDINATOR
NORTH AMERICA GAS AND POWER
501 WESTLAKE PARK BLVD.
HOUSTON, TX 77079
R.06-04-009

MARTIN A. MATTES
NOSSAMAN GUTHNER KNOX & ELLIOTT, LLP
50 CALIFORNIA STREET,SUITE 3400
SAN FRANCISCO, CA 94111
R.06-04-009

DANIELLE MATTHEWS SEPERAS
CALPINE CORPORATION
1127 11TH STREET, SUITE 242
SACRAMENTO, CA 95814
R.06-04-009

MICHAEL MAZUR
CHIEF TECHNICAL OFFICER
3 PHASES RENEWABLES, LLC
8333 ZITOLA TER
PLAYA DEL REY, CA 90293-7835
R.06-04-009

ANDREW MCALLISTER
DIRECTOR OF OPERATIONS
CALIFORNIA CENTER FOR SUSTAINABLE ENERGY
8690 BALBOA AVE., SUITE 100
SAN DIEGO, CA 92123
R.06-04-009

THOMAS MCCABE
EDISON MISSION ENERGY
18101 VON KARMAN AVE., SUITE 1700
IRVINE, CA 92612
R.06-04-009

RICHARD MCCANN
M.CUBED
2655 PORTAGE BAY ROAD, SUITE 3
DAVIS, CA 95616
R.06-04-009

BARRY F. MCCARTHY
ATTORNEY AT LAW
MCCARTHY & BERLIN, LLP
100 PARK CENTER PLAZA, SUITE 501
SAN JOSE, CA 95113
R.06-04-009

WADE MCCARTNEY
REGULATORY ANALYST IV
PUBLIC UTILITIES COMMISSION
770 L STREET, SUITE 1050
SACRAMENTO, CA 95814
R.06-04-009

KEITH R. MCCREA
ATTORNEY AT LAW
SUTHERLAND, ASBILL & BRENNAN, LLP
1275 PENNSYLVANIA AVE., N.W.
WASHINGTON, DC 20004-2415
R.06-04-009

MARY MCDONALD
DIRECTOR OF STATE AFFAIRS
CALIFORNIA INDEPENDENT SYSTEM OPERATOR
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

JEN MCGRAW
CENTER FOR NEIGHBORHOOD TECHNOLOGY
PO BOX 14322
SAN FRANCISCO, CA 94114
R.06-04-009

BRUCE MCLAUGHLIN
BRAUN & BLAISING P.C.
915 L STREET, SUITE 1460
SACRAMENTO, CA 95814
R.06-04-009

RACHEL MCMAHON
CEERT
1100 11TH STREET, SUITE 311
SACRAMENTO, CA 95814
R.06-04-009

BRIAN MCQUOWN
RELIANT ENERGY
7251 AMIGO ST., SUITE 120
LAS VEGAS, NV 89119
R.06-04-009

ELENA MELLO
SIERRA PACIFIC POWER COMPANY
6100 NEIL ROAD
RENO, NV 89520
R.06-04-009

DARYL METZ
CALIFORNIA ENERGY COMMISSION
1516 9TH ST., MS-20
SACRAMENTO, CA 95814
R.06-04-009

STEVEN S. MICHEL
WESTERN RESOURCE ADVOCATES
2025 SENDA DE ANDRES
SANTA FE, NM 87501
R.06-04-009

ROSS MILLER
CALIFORNIA ENERGY COMMISSION
1516 9TH STREET
SACRAMENTO, CA 95814
R.06-04-009

KAREN NORENE MILLS
ATTORNEY AT LAW
CALIFORNIA FARM BUREAU FEDERATION
2300 RIVER PLAZA DRIVE
SACRAMENTO, CA 95833
R.06-04-009

MARCIE MILNER
DIRECTOR - REGULATORY AFFAIRS
SHELL TRADING GAS & POWER COMPANY
4445 EASTGATE MALL, SUITE 100
SAN DIEGO, CA 92121
R.06-04-009

SAMARA MINDEL
REGULATORY AFFAIRS ANALYST
FELLON-MCCORD & ASSOCIATES
9960 CORPORATE CAMPUS DRIVE, SUITE 2000
LOUISVILLE, KY 40223
R.06-04-009

CYNTHIA MITCHELL
ENERGY ECONOMICS, INC.
530 COLGATE COURT
RENO, NV 89503
R.06-04-009

Ed Moldavsky
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5125
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Rahmon Momoh
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4205
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Beth Moore
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4103
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Harvey Y. Morris
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5036
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Lainie Motamedi
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5119
SAN FRANCISCO, CA 94102-3214
R.06-04-009

DAVID L. MODISETTE
CALIFORNIA ELECTRIC TRANSP. COALITION
1015 K STREET, SUITE 200
SACRAMENTO, CA 95814
R.06-04-009

WES MONIER
STRATEGIC ISSUES AND PLANNING MANAGER
TURLOCK IRRIGATION DISTRICT
333 EAST CANAL DRIVE, PO BOX 949
TURLOCK, CA 95381-0949
R.06-04-009

ROGER C. MONTGOMERY
VICE PRESIDENT, PRICING
SOUTHWEST GAS CORPORATION
PO BOX 98510
LAS VEGAS, NV 89193-8510
R.06-04-009

RONALD MOORE
GOLDEN STATE WATER/BEAR VALLEY ELECTRIC
630 EAST FOOTHILL BOULEVARD
SAN DIMAS, CA 91773
R.06-04-009

RICHARD J. MORILLO
ASSISTANT CITY ATTORNEY
CITY OF BURBANK
215 E. OLIVE AVENUE
BURBANK, CA 91502
R.06-04-009

GREGORY MORRIS
GREEN POWER INSTITUTE
2039 SHATTUCK AVE., SUITE 402
BERKELEY, CA 94704
R.06-04-009

STEVEN MOSS
SAN FRANCISCO COMMUNITY POWER COOP
2325 3RD STREET, SUITE 344
SAN FRANCISCO, CA 94120
R.06-04-009

MATTHEW MOST
EDISON MISSION MARKETING & TRADING, INC.
160 FEDERAL STREET
BOSTON, MA 02110-1776
R.06-04-009

Scott Murtishaw
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

PHILLIP J. MULLER
SCD ENERGY SOLUTIONS
436 NOVA ALBION WAY
SAN RAFAEL, CA 94903
R.06-04-009

CLYDE MURLEY
CONSULTANT TO NRDC
1031 ORDWAY STREET
ALBANY, CA 94706
R.06-04-009

Richard A. Myers
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

SARA STECK MYERS
ATTORNEY AT LAW
LAW OFFICES OF SARA STECK MYERS
122 - 28TH AVENUE
SAN FRANCISCO, CA 94121
R.06-04-009

JESSICA NELSON
PLUMAS-SIERRA RURAL ELECTRIC CO-OP
73233 STATE ROUTE 70, STE A
PORTOLA, CA 96122-7064
R.06-04-009

DAVID NEMTZOW
1254 9TH STREET, NO. 6
SANTA MONICA, CA 90401
R.06-04-009

SID NEWSOM
TARIFF MANAGER
SOUTHERN CALIFORNIA GAS COMPANY
555 WEST 5TH STREET
LOS ANGELES, CA 90051
R.06-04-009

DESPINA NIEHAUS
SAN DIEGO GAS AND ELECTRIC COMPANY
8330 CENTURY PARK COURT, CP32H
SAN DIEGO, CA 92123-1530
R.06-04-009

SEPHRA A. NINOW
POLICY ANALYST
CALIFORNIA CENTER FOR SUSTAINABLE ENERGY
8690 BALBOA AVENUE, SUITE 100
SAN DIEGO, CA 92123
R.06-04-009

RICK C. NOGER
PRAXAIR PLAINFIELD, INC.
2711 CENTERVILLE ROAD, SUITE 400
WILMINGTON, DE 19808
R.06-04-009

RITA NORTON
RITA NORTON AND ASSOCIATES, LLC
18700 BLYTHSWOOD DRIVE,
LOS GATOS, CA 95030
R.06-04-009

SHAUNA O'DONNELL
CALIFORNIA ENERGY MARKETS
517-B POTRERO AVE.
SAN FRANCISCO, CA 94110-1431
R.06-04-009

TIMOTHY R. ODIL
MCKENNA LONG & ALDRIDGE LLP
1875 LAWRENCE STREET, SUITE 200
Center for Energy and Economic Development
DENVER, CO 80202
R.06-04-009

ALVIN PAK
SEMPRA GLOBAL ENTERPRISES
101 ASH STREET
SAN DIEGO, CA 92101
R.06-04-009

LAURIE PARK
NAVIGANT CONSULTING, INC.
3100 ZINFANDEL DRIVE, SUITE 600
RANCHO CORDOVA, CA 95670-6078
R.06-04-009

LORRAINE PASKETT
DIRECTOR, LEGISLATIVE AND REG. AFFAIRS
LA DEPT. OF WATER & POWER
111 N. HOWARD ST., ROOM 1536
LOS ANGELES, CA 90012
R.06-04-009

SHERIDAN J. PAUKER
WILSON SONSINI GOODRICH & ROSATI
ONE MARKET ST
SAN FRANCISCO, CA 94105
R.06-04-009

JOSEPH M. PAUL
SENIOR CORPORATE COUNSEL
WEST COAST POWER
2420 CAMINO RAMON, BLDG. J, SUITE 215
SAN RAMON, CA 94583
R.06-04-009

Joel T. Perlstein
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5133
SAN FRANCISCO, CA 94102-3214
R.06-04-009

CARL PECHMAN
POWER ECONOMICS
901 CENTER STREET
SANTA CRUZ, CA 95060
R.06-04-009

NORMAN A. PEDERSEN
ATTORNEY AT LAW
HANNA & MORTON
444 S. FLOWER STREET, SUITE 1500
LOS ANGELES, CA 90071
R.06-04-009

JANIS C. PEPPER
CLEAN POWER MARKETS, INC.
PO BOX 3206
LOS ALTOS, CA 94024
R.06-04-009

CARLA PETERMAN
UCEI
2547 CHANNING WAY
BERKELEY, CA 94720
R.06-04-009

COLIN PETHERAM
DIRECTOR-REGULATORY
SBC CALIFORNIA
140 NEW MONTGOMERY ST., SUITE 1325
SAN FRANCISCO, CA 94105
R.06-04-009

ROBERT L. PETTINATO
LOS ANGELES DEPARTMENT OF POWER & WATER
111 NORTH HOPE STREET, ROOM 1151
LOS ANGELES, CA 90012-0100
R.06-04-009

PHILIP D. PETTINGILL
CALIFORNIA INDEPENDENT SYSTEM OPERATOR
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

Paul S Phillips
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4101
SAN FRANCISCO, CA 94102-3214
R.06-04-009

GORDON PICKERING
PRINCIPAL
NAVIGANT CONSULTING, INC.
3100 ZINFANDEL DRIVE, SUITE 600
RANCHO CORDOVA, CA 95670-6078
R.06-04-009

EDWARD G. POOLE
ANDERSON DONOVAN & POOLE
601 CALIFORNIA STREET, SUITE 1300
SAN FRANCISCO, CA 94108
R.06-04-009

JENNIFER PORTER
POLICY ANALYST
CALIFORNIA CENTER FOR SUSTAINABLE ENERGY
8690 BALBOA AVENUE, SUITE 100
SAN DIEGO, CA 92123
R.06-04-009

BRIAN POTTS
Foley & Lardner
150 East Gilman Street
1497
MADISON, WI 53701-1497
R.06-04-009

VIDHYA PRABHAKARAN
GOODIN,MACBRIDE,SQUERI,DAY,LAMPREY
505 SANSOME STREET, SUITE 900
SAN FRANCISCO, CA 94111
R.06-04-009

RASHA PRINCE
SOUTHERN CALIFORNIA GAS COMPANY
555 WEST 5TH STREET, GT14D6
LOS ANGELES, CA 90013
R.06-04-009

JJ PRUCNAL
SOUTHWEST GAS CORPORATION
PO BOX 98510
LAS VEGAS, NV 89193-8510
R.06-04-009

MARC PRYOR
CALIFORNIA ENERGY COMMISSION
1516 9TH ST., MS-20
SACRAMENTO, CA 95814
R.06-04-009

BALWANT S. PUREWAL
DEPARTMENT OF WATER RESOURCES
3310 EL CAMINO AVE., LL-90
SACRAMENTO, CA 95821
R.06-04-009

Kristin Ralff Douglas
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5119
SAN FRANCISCO, CA 94102-3214
R.06-04-009

BARRY RABE
1427 ROSS STREET
PLYMOUTH, MI 48170
R.06-04-009

STEVE RAHON
DIRECTOR, TARIFF & REGULATORY ACCOUNTS
SAN DIEGO GAS & ELECTRIC COMPANY
8330 CENTURY PARK COURT, CP32C
SAN DIEGO, CA 92123-1548
R.06-04-009

TIFFANY RAU
POLICY AND COMMUNICATIONS MANAGER
CARSON HYDROGEN POWER PROJECT LLC
ONE WORLD TRADE CENTER, SUITE 1600
LONG BEACH, CA 90831-1600
R.06-04-009

JOHN R. REDDING
ARCTURUS ENERGY CONSULTING, INC.
44810 ROSEWOOD TERRACE
MENDOCINO, CA 95460-9525
R.06-04-009

ROBERT J. REINHARD
MORRISON AND FOERSTER
425 MARKET STREET
SAN FRANCISCO, CA 94105-2482
R.06-04-009

DAVID REYNOLDS
MEMBER SERVICES MANAGER
NORTHERN CALIFORNIA POWER AGENCY
180 CIRBY WAY
ROSEVILLE, CA 95678-6420
R.06-04-009

JANILL RICHARDS
DEPUTY ATTORNEY GENERAL
CALIFORNIA ATTORNEY GENERAL'S OFFICE
1515 CLAY STREET, 20TH FLOOR
OAKLAND, CA 94702
R.06-04-009

Steve Roscow
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

THEODORE ROBERTS
ATTORNEY AT LAW
SEMPRA GLOBAL
101 ASH STREET, HQ 13D
SAN DIEGO, CA 92101-3017
R.06-04-009

GRANT A. ROSENBLUM
SENIOR COUNSEL
CALIFORNIA INDEPENDENT SYSTEM OPERATOR
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

JIM ROSS
RCS, INC.
500 CHESTERFIELD CENTER, SUITE 320
CHESTERFIELD, MO 63017
R.06-04-009

ROBERT K. ROZANSKI
LOS ANGELES DEPT OF WATER AND POWER
111 NORTH HOPE STREET, ROOM 1520
LOS ANGELES, CA 90012
R.06-04-009

Nancy Ryan
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5217
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Pearlie Sabino
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4209
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Jason R. Salmi Klotz
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

RANDY SABLE
SOUTHWEST GAS CORPORATION
5241 SPRING MOUNTAIN ROAD
LAS VEGAS, NV 89193
R.06-04-009

SAM SADLER
OREGON DEPARTMENT OF ENERGY
625 NE MARION STREET
SALEM, OR 97301-3737
R.06-04-009

JUDITH B. SANDERS
ATTORNEY AT LAW
CALIFORNIA INDEPENDENT SYSTEM OPERATOR
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

SOUMYA SASTRY
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000
SAN FRANCISCO, CA 94177
R.06-04-009

Don Schultz
CALIF PUBLIC UTILITIES COMMISSION
770 L STREET, SUITE 1050
SACRAMENTO, CA 95814
R.06-04-009

JANINE L. SCANCARELLI
FOLGER LEVIN & KAHN LLP
275 BATTERY STREET, 23RD FLOOR
SAN FRANCISCO, CA 94111
R.06-04-009

MICHAEL SCHEIBLE
DEPUTY EXECUTIVE OFFICER
CALIFORNIA AIR RESOURCES BOARD
1001 I STREET
SACRAMENTO, CA 95677
R.06-04-009

JENINE SCHENK
APS ENERGY SERVICES
400 E. VAN BUREN STREET, SUITE 750
PHOENIX, AZ 85004
R.06-04-009

STEVEN SCHILLER
SCHILLER CONSULTING, INC.
111 HILLSIDE AVENUE
PIEDMONT, CA 94611
R.06-04-009

STEVEN S. SCHLEIMER
DIRECTOR,COMPLIANCE & REGULATORY AFFAIRS
BARCLAYS BANK, PLC
200 PARK AVENUE, FIFTH FLOOR
NEW YORK, NY 10166
R.06-04-009

REED V. SCHMIDT
BARTLE WELLS ASSOCIATES
1889 ALCATRAZ AVENUE
BERKELEY, CA 94703-2714
R.06-04-009

DONALD SCHOENBECK
RCS, INC.
900 WASHINGTON STREET, SUITE 780
VANCOUVER, WA 98660
R.06-04-009

BILL SCHRAND
SOUTHWEST GAS CORPORATON
PO BOX 98510
LAS VEGAS, NV 89193-8510
R.06-04-009

CYNTHIA SCHULTZ
REGULATORY FILING COORDINATOR
PACIFIC POWER AND LIGHT COMPANY
825 N.E. MULTNOMAH
PORTLAND, OR 97232
R.06-04-009

LISA SCHWARTZ
SENIOR ANALYST
ORGEON PUBLIC UTILITY COMMISSION
PO BOX 2148
SALEM, OR 97308-2148
R.06-04-009

MONICA A. SCHWEBS, ESQ.
BINGHAM MCCUTCHEN LLP
1333 N. CALIFORNIA BLVD., SUITE 210
WALNUT CREEK, CA 94596
R.06-04-009

PAUL M. SEBY
MCKENNA LONG & ALDRIDGE LLP
1875 LAWRENCE STREET, SUITE 200
DENVER, CO 80202
R.06-04-009

BETTY SETO
POLICY ANALYST
KEMA, INC.
492 NINTH STREET, SUITE 220
OAKLAND, CA 94607
R.06-04-009

NORA SHERIFF
ATTORNEY AT LAW
ALCANTAR & KAHL LLP
120 MONTGOMERY STREET, SUITE 2200
SAN FRANCISCO, CA 94104
R.06-04-009

Sean A. Simon
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

KYLE SILON
ECOSECURITIES CONSULTING LIMITED
529 SE GRAND AVENUE
PORTLAND, OR 97214
R.06-04-009

DAN SILVERIA
SURPRISE VALLEY ELECTRIC CORPORATION
PO BOX 691
ALTURAS, CA 96101
R.06-04-009

KEVIN J. SIMONSEN
ENERGY MANAGEMENT SERVICES
646 EAST THIRD AVENUE
DURANGO, CO 81301
R.06-04-009

DAN SKOPEC
CLIMATE & ENERGY CONSULTING
1201 K STREET SUITE 970
SACRAMENTO, CA 95814
R.06-04-009

DEBORAH SLON
DEPUTY ATTORNEY GENERAL, ENVIRONMENT
OFFICE OF THE ATTORNEY GENERAL
1300 I STREET, 15TH FLOOR
SACRAMENTO, CA 95814
R.06-04-009

Donald R. Smith
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4209
SAN FRANCISCO, CA 94102-3214
R.06-04-009

GLORIA D. SMITH
ADAMS, BROADWELL, JOSEPH & CARDOZO
601 GATEWAY BLVD., SUITE 1000
SOUTH SAN FRANCISCO, CA 94080
R.06-04-009

KELLIE SMITH
SENATE ENERGY/UTILITIES & COMMUNICATION
STATE CAPITOL, ROOM 4038
SACRAMENTO, CA 95814
R.06-04-009

RICHARD SMITH
MODESTO IRRIGATION DISTRICT
1231 11TH STREET
MODESTO, CA 95352-4060
R.06-04-009

ROBIN SMUTNY-JONES
CALIFORNIA ISO
151 BLUE RAVINE ROAD
FOLSOM, CA 95630
R.06-04-009

JEANNE M. SOLE
DEPUTY CITY ATTORNEY
CITY AND COUNTY OF SAN FRANCISCO
1 DR. CARLTON B. GOODLETT PLACE, RM. 234
SAN FRANCISCO, CA 94102
R.06-04-009

DARRELL SOYARS
MANAGER-RESOURCE PERMITTING&STRATEGIC
SIERRA PACIFIC RESOURCES
6100 NEIL ROAD
RENO, NV 89520-0024
R.06-04-009

JAMES D. SQUERI
ATTORNEY AT LAW
GOODIN MACBRIDE SQUERI RITCHIE & DAY LLP
505 SANSOME STREET, STE 900
SAN FRANCISCO, CA 94111
R.06-04-009

SEEMA SRINIVASAN
ATTORNEY AT LAW
ALCANTAR & KAHL, LLP
120 MONTGOMERY STREET, SUITE 2200
SAN FRANCISCO, CA 94104
R.06-04-009

F. Jackson Stoddard
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5040
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Elizabeth Stoltzfus
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

ANNIE STANGE
ALCANTAR & KAHL
1300 SW FIFTH AVE., SUITE 1750
PORTLAND, OR 97201
R.06-04-009

FRANK STERN
SUMMIT BLUE CONSULTING
1722 14TH STREET, SUITE 230
BOULDER, CO 80302
R.06-04-009

PATRICK STONER
PROGRAM DIRECTOR
LOCAL GOVERNMENT COMMISSION
1303 J STREET, SUITE 250
SACRAMENTO, CA 95814
R.06-04-009

NINA SUETAKE
ATTORNEY AT LAW
THE UTILITY REFORM NETWORK
711 VAN NESS AVE., STE 350
SAN FRANCISCO, CA 94102
R.06-04-009

KENNY SWAIN
NAVIGANT CONSULTING
3100 ZINFANDEL DRIVE, SUITE 600
RANCHO CORDOVA, CA 95670
R.06-04-009

Jeorge S Tagnipes
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ENERGY DIVISION AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

Christine S Tam
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 4209
SAN FRANCISCO, CA 94102-3214
R.06-04-009

JAMES W. TARNAGHAN
DUANE MORRIS LLP
ONE MARKET, SPEAR TOWER
SAN FRANCISCO, CA 94105
R.06-04-009

WEBSTER TASAT
AIR RESOURCES BOARD
1001 I STREET
SACRAMENTO, CA 95814
R.06-04-009

ROBERT R. TAYLOR
AGRICULTURAL IMPROVEMENT AND POWER DIST.
1600 NORTH PRIEST DRIVE, PAB221
TEMPE, AZ 85281
R.06-04-009

Charlotte TerKeurst
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
ROOM 5117
SAN FRANCISCO, CA 94102-3214
R.06-04-009

KAREN TERRANOVA
ALCANTAR & KAHL, LLP
120 MONTGOMERY STREET, STE 2200
SAN FRANCISCO, CA 94104
R.06-04-009

PATRICIA THOMPSON
SUMMIT BLUE CONSULTING
2920 CAMINO DIABLO, SUITE 210
WALNUT CREEK, CA 94597
R.06-04-009

DEAN R. TIBBS
PRESIDENT
ADVANCED ENERGY STRATEGIES, INC.
1390 WILLOW PASS ROAD, SUITE 610
CONCORD, CA 94520
R.06-04-009

EDWARD J TIEDEMANN
ATTORNEY AT LAW
KRONICK, MOSKOVITZ, TIEDEMANN & GIRARD
400 CAPITOL MALL, 27TH FLOOR
SACRAMENTO, CA 95814-4416
R.06-04-009

SCOTT TOMASHEFSKY
NORTHERN CALIFORNIA POWER AGENCY
180 CIRBY WAY
ROSEVILLE, CA 95678-6420
R.06-04-009

WAYNE TOMLINSON
EL PASO CORPORATION
2 NORTH NEVADA AVENUE
COLORADO SPRINGS, CO 80903
R.06-04-009

Lana Tran
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 2-D
SAN FRANCISCO, CA 94102-3214
R.06-04-009

ALLEN K. TRIAL
SAN DIEGO GAS & ELECTRIC COMPANY
101 ASH STREET
SAN DIEGO, CA 92101
R.06-04-009

NANCY TRONAAS
CALIFORNIA ENERGY COMMISSION
1516 9TH ST. MS-20
SACRAMENTO, CA 95814-5512
R.06-04-009

ANN L. TROWBRIDGE
ATTORNEY AT LAW
DAY CARTER & MURPHY, LLP
3620 AMERICAN RIVER DRIVE, SUITE 205
SACRAMENTO, CA 95864
R.06-04-009

ANDREW J. VAN HORN
VAN HORN CONSULTING
12 LIND COURT
ORINDA, CA 94563
R.06-04-009

ROGER VAN HOY
MODESTO IRRIGATION DISTRICT
1231 11TH STREET
MODESTO, CA 95354
R.06-04-009

BETH VAUGHAN
CALIFORNIA COGENERATION COUNCIL
4391 N. MARSH ELDER COURT
CONCORD, CA 94521
R.06-04-009

EDWARD VINE
LAWRENCE BERKELEY NATIONAL LABORATORY
BUILDING 90R4000
BERKELEY, CA 94720
R.06-04-009

SYMONE VONGDEUANE
SEMPRA ENERGY SOLUTIONS
101 ASH STREET, HQ09
SAN DIEGO, CA 92101-3017
R.06-04-009

BARRY R. WALLERSTEIN
EXECUTIVE OFFICER
SOUTH COAST AQMD
21865 COPLEY DRIVE
DIAMOND BAR, CA 91765-4182
R.06-04-009

DEVRA WANG
NATURAL RESOURCES DEFENSE COUNCIL
111 SUTTER STREET, 20TH FLOOR
SAN FRANCISCO, CA 94104
R.06-04-009

CHRISTOPHER J. WARNER
PACIFIC GAS AND ELECTRIC COMPANY
77 BEALE STREET, PO BOX 7442
SAN FRANCISCO, CA 94120-7442
R.06-04-009

JOY A. WARREN
REGULATORY ADMINISTRATOR
MODESTO IRRIGATION DISTRICT
1231 11TH STREET
MODESTO, CA 95354
R.06-04-009

Pamela Wellner
CALIF PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
AREA 4-A
SAN FRANCISCO, CA 94102-3214
R.06-04-009

LISA WEINZIMER
CALIFORNIA ENERGY REPORTER
PLATTS MCGRAW-HILL
695 NINTH AVENUE, NO. 2
SAN FRANCISCO, CA 94118
R.06-04-009

ROBERT B. WEISENMILLER
PHD
MRW & ASSOCIATES, INC.
1814 FRANKLIN STREET, SUITE 720
OAKLAND, CA 94612
R.06-04-009

RAY WELCH
ASSOCIATE DIRECTOR
NAVIGANT CONSULTING, INC.
ONE MARKET PLAZA, SUITE 1200
SAN FRANCISCO, CA 94105
R.06-04-009

VIRGIL WELCH
CLIMATE CAMPAIGN COORDINATOR
ENVIRONMENTAL DEFENSE
1107 9TH STREET, SUITE 540
SACRAMENTO, CA 95814
R.06-04-009

JOHN B. WELDON, JR.
SALMON, LEWIS & WELDON, P.L.C.
2850 EAST CAMELBACK ROAD, SUITE 200
PHOENIX, AZ 85016
R.06-04-009

ANDREA WELLER
STRATEGIC ENERGY
3130 D BALFOUR RD., SUITE 290
BRENTWOOD, CA 94513
R.06-04-009

ELIZABETH WESTBY
ALCANTAR & KAHL LLP
1300 SW FIFTH AVENUE, SUITE 1750
PORTLAND, OR 97201
R.06-04-009

WILLIAM W. WESTERFIELD, 111
ATTORNEY AT LAW
ELLISON, SCHNEIDER & HARRIS L.L.P.
2015 H STREET
SACRAMENTO, CA 95814
R.06-04-009

BRAD WETSTONE
236 HARTFORD STREET
SAN FRANCISCO, CA 94114
R.06-04-009

S. NANCY WHANG
ATTORNEY AT LAW
MANATT, PHELPS & PHILLIPS, LLP
11355 WEST OLYMPIC BLVD.
LOS ANGELES, CA 90064
R.06-04-009

GREGGORY L. WHEATLAND
ATTORNEY AT LAW
ELLISON, SCHNEIDER & HARRIS, LLP
2015 H STREET
SACRAMENTO, CA 95814
R.06-04-009

JOSEPH F. WIEDMAN
ATTORNEY AT LAW
GOODIN MACBRIDE SQUERI DAY &
LAMPREY LLP
505 SANSOME STREET, SUITE 900
SAN FRANCISCO, CA 94111
R.06-04-009

KATHRYN WIG
PARALEGAL
NRG ENERGY, INC
211 CARNEGIE CENTER
PRINCETON, NY 8540
R.06-04-009

VALERIE J. WINN
PACIFIC GAS AND ELECTRIC COMPANY
PO BOX 770000, B9A
SAN FRANCISCO, CA 94177-0001
R.06-04-009

REID A. WINTHROP
PILOT POWER GROUP, INC
8910 UNIVERSITY CENTER LANE SUITE 520
SAN DIEGO, CA 92122
R.06-04-009

RYAN WISER
BERKELEY LAB
ONE CYCLOTRON ROAD
BERKELEY, CA 94720
R.06-04-009

ELLEN WOLFE
RESERO CONSULTING
9289 SHADOW BROOK PL.
GRANITE BAY, CA 95746
R.06-04-009

KEVIN WOODRUFF
WOODRUFF EXPERT SERVICES, INC.
1100 K STREET, SUITE 204
SACRAMENTO, CA 95814
R.06-04-009

DON WOOD
PACIFIC ENERGY POLICY CENTER
4539 LEE AVENUE
LA MESA, CA 91941
R.06-04-009

CATHY S. WOOLLUMS
MIDAMERICAN ENERGY HOLDINGS
COMPANY
106 EAST SECOND STREET
DAVENPORT, IA 52801
R.06-04-009

E.J. WRIGHT
OCCIDENTAL POWER SERVICES, INC.
5 GREENWAY PLAZA, SUITE 110
HOUSTON, TX 77046
R.06-04-009

JUSTIN C. WYNNE
BRAU & BLAISING, P.C.
915 L STREET, SUITE 1270
SACRAMENTO, CA 95814
R.06-04-009

HUGH YAO
SOUTHERN CALIFORNIA GAS COMPANY
555 W. 5TH ST, GT22G2
LOS ANGELES, CA 90013
R.06-04-009

JEANNE ZAIONTZ
BP ENERGY COMPANY
501 WESTLAKE PARK BLVD, RM. 4328
HOUSTON, TX 77079
R.06-04-009

ELIZABETH ZELLJADT
1725 I STREET, N.W. SUITE 300
WASHINGTON, DC 20006
R.06-04-009

DAVID ZONANA
DEPUTY ATTORNEY GENERAL
CALIFORNIA ATTORNEY GENERAL'S OFFICE
455 GOLDEN GATE AVENUE, SUITE 11000
SAN FRANCISCO, CA 94102
R.06-04-009

LEGAL & REGULATORY DEPARTMENT
CALIFORNIA INDEPENDENT SYS OPE CORPORATI
151 BLUE RAVINE RD.
FOLSOM, CA 95630
R.06-04-009