

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

Application of Pacific Gas and Electric
Company for Approval of Zonal
Electrification Project

Application No. 22-08-003

**REBUTTAL TESTIMONY OF ROBERT EARLE ON BEHALF OF
THE COALITION OF CALIFORNIA UTILITY EMPLOYEES**

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TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	PG&E’S PROPOSAL CAN NOT BE JUSTIFIED BASED ON COST CAUSATION BY GAS RATEPAYERS	2
III.	PG&E’S OWN ANALYSIS SHOWS THAT ITS PROPOSAL IS NOT COST-EFFECTIVE FOR GAS RATEPAYERS.....	4
IV.	AS A TRANSACTION BETWEEN GAS RATEPAYERS AND CSU MONTEREY BAY, PG&E’S PROPOSAL IS A LOUSY DEAL FOR RATEPAYERS.....	6
V.	PG&E’S CALCULATION OF BENEFITS LEAVES OUT CRUCIAL COMPONENTS AND THEREFORE SHOULD BE REJECTED.....	7
	A. PG&E Does Not Include Increased Costs to Gas Ratepayers from the Death Spiral.....	8
	B. PG&E Does Not Take into Account the Risks that Gas Ratepayers Bear Under its Proposal.....	9
VI.	TO AVOID THE DEATH SPIRAL ELECTRIFICATION PROJECTS MUST HELP GAS CUSTOMERS NOT HURT THEM AS IN PG&E’S PROPOSAL	10
VII.	CONCLUSIONS.....	10

Attachment A – PG&E Residential Average Gas Rates

Attachment B – Curriculum Vitae of Dr. Robert Earle

1 **I. INTRODUCTION**

2 Suppose you and a friend are walking in the park and you both come across a hundred-
3 dollar bill on the ground. You both exclaim at the same time, “A hundred dollars!” You look
4 around to see if someone has dropped it that you can identify and return it to, but you don’t see
5 anyone. Your friend says to you, “Let’s split it.” You think, “Oh, that’s great, the 50 dollars will
6 help with my grocery shopping.” So, your friend takes the 100 dollar bill, puts it in his wallet,
7 then fishes out six dollars from his wallet and 2 quarters from his pocket and gives them to you.
8 You are naturally a little confused and say “Where’s the rest of it, \$43.50?” Your friend replies,
9 “What do you mean? We’re splitting the 100 dollars! I get \$93.50, you get \$6.50.¹ We both gain.
10 It’s a ‘win-win.’”

11 Clearly, if your friend behaved like that, he would not be much of a friend (though
12 perhaps he has other good qualities). But as discussed below, this scenario is much fairer than
13 what PG&E is proposing. The Commission should reject PG&E’s proposal for gas ratepayers to
14 pay for CSU Monterey Bay’s electrification because it violates basic ratemaking principles and
15 is unfair to gas ratepayers.

16 PG&E has proposed to convert part of CSU Monterey Bay into all-electric service.
17 According to PG&E, the electrification has a present value cost of \$14.4 million, while the
18 continuation of gas service would entail present value costs of \$15.4 million. PG&E proposes
19 that all the costs for electrification be borne by its gas ratepayers.

¹ Under PG&E’s proposal the net present value of cash costs of electrification is \$14.4 million, and the avoided costs of conventional gas pipe replacement are \$15.4, resulting in a net benefit of approximately \$1.0 million to customers (Amended Application, p. 6). $1.0/15.4 = .065$.

1 PG&E’s proposal is problematic and should be rejected. If PG&E’s proposal is a
2 ratemaking proposal, it violates the fundamental principle of cost causation. The costs borne by
3 ratepayers should follow the costs caused by ratepayers. In other words, either CSU Monterey
4 Bay should bear all the costs of the project, or share them with other electric ratepayers. Gas
5 ratepayers should not pay for any part of the project.

6 On the other hand, if one construes PG&E’s proposal not as a matter of ratemaking for
7 gas ratepayers, but rather as a “deal” with shared benefits between PG&E’s gas ratepayers and
8 CSU Monterey Bay, then it is a lousy deal for gas ratepayers. Moreover, PG&E uses the
9 incorrect metric to judge cost-effectiveness. Even if PG&E’s calculations are correct, their
10 proposal gives pennies on the dollar in benefits to gas ratepayers and a windfall to CSU
11 Monterey Bay. But, PG&E’s calculation leaves out two crucial components that make their
12 proposal a non-starter. First, PG&E’s calculation does not include the increased rates paid by gas
13 ratepayers because the exited CSU Monterey Bay gas ratepayers will no longer contribute to
14 fixed costs. Second, there are numerous elements of risk and potential additional costs that are
15 not addressed in PG&E’s proposal.

16 **II. PG&E’S PROPOSAL CAN NOT BE JUSTIFIED BASED ON COST**
17 **CAUSATION BY GAS RATEPAYERS**

18 PG&E proposes that the costs of the electrification be recovered from gas ratepayers.²
19 Indicated Shippers disagrees,³ making two important points. First, “[t]he costs of the CSUMB
20 electric appliances are not costs incurred to provide gas delivery service to PG&E’s remaining
21 gas delivery service ratepayers.”⁴ Second, “[t]hough it is a choice for CSUMB to electrify,

² PG&E Amended Testimony, p. 1-2:22-25.

³ Indicated Shippers, Opening Testimony, p. 1-2:33-34.

⁴ Indicated Shippers, p. 1-2:35-37.

1 PG&E proposes that the costs associated with that choice be borne, not by CSUMB, but by the
2 remaining gas ratepayers of PG&E.”⁵ CUE agrees with Indicated Shippers.

3 PG&E wants to put the costs of electrification into gas rates and earn a rate of return on
4 them.⁶ However, the costs incurred for electrification are not for equipment that will be used and
5 useful for gas ratepayers, but rather equipment that is to be used by electric ratepayers. The costs
6 incurred for electrification are not incurred for the sake of providing gas service. In fact, the costs
7 incurred for electrification are incurred for the very opposite: *not* providing gas service. The
8 Commission has stated:⁷

9 Developing equitable rates based on the principle of cost causation is one of the
10 underlying goals of the Commission's rate making process. Cost causation means that
11 costs should be borne by those customers who cause the utility to incur the expense.

12 FERC’s approach has been similar:⁸

13 Under the cost causation principle, ‘it has been traditionally required that all approved
14 rates reflect to some degree the costs actually caused by the customer who must pay
15 them.’

16 Gas ratepayers are not imposing electrification costs on PG&E. The CSU Monterey Bay
17 electrification project was requested by CSU Monterey Bay according to PG&E,⁹ and it is the
18 beneficiary of the electrification. Under cost causation principles, CSU Monterey Bay should pay
19 for the electrification. PG&E’s proposal does not pass the cost causation test.

⁵ Indicated Shippers, p. 1-3:14-15. Pdf page 9.

⁶ Amended Application, p. 3.

⁷ R1206013 OIR, p. 13.

⁸ 137 FERC ¶ 61075.

⁹ Amended Application, p. 1.

1 The Commission should not impose any costs from the CSU Monterey Bay
2 electrification project on gas ratepayers.

3 **III. PG&E’S OWN ANALYSIS SHOWS THAT ITS PROPOSAL IS NOT**
4 **COST-EFFECTIVE FOR GAS RATEPAYERS**

5 PG&E implies that its proposal is cost-effective stating “[w]hen the NPV of non-pipeline
6 alternative project is less than that of a planned gas repair capital cost, that demonstrates that the
7 electrification will be a safety and financial benefit to all gas ratepayers.”¹⁰ This is, of course,
8 arrant nonsense, as pointed out by both Indicated Shippers and EDF.¹¹ Even if one believes
9 PG&E’s calculations to be correct, PG&E’s own analysis shows that gas ratepayers pay more
10 under PG&E’s proposal than they would otherwise.¹² Gas ratepayers do not pay the NPV of the
11 costs incurred by PG&E; rather, gas ratepayers pay the present value of revenue requirements
12 (PVRR). Therefore, the PVRR comparison is the correct one. Table 1 (from Indicated Shippers)
13 shows the comparison.

¹⁰ PG&E Amended Testimony, p. 1-2:19-22.

¹¹ Indicated Shippers Opening Testimony, p. 3-3:7-3-4. EDF Opening Testimony, p. 10:14-11:5.

¹² PG&E Amended Testimony, p. 3-6.

1 Table 1: ¹³ Summary of Present Value of Revenue Requirement by Phase

Line No.	Project Phase	Conventional Gas Pipe Replacement Revenue Requirements	Electrification Revenue Requirements
1	Phase 1	\$6,707,067	\$4,578,528
2	Phase 2	4,338,252	7,457,078
3	Phase 3	5,641,458	5,659,091
4	Phase 4	986,144	...(a)
5	Total, Phases 1-4	\$16,686,777	\$17,694,697

(a) The revenue requirement associated with retiring existing gas pipelines is not presented for comparison here, as recovery of those expenditures are included in the 2023 GRC.

2
 3 If the criteria were simply the economic efficiency of the proposal without respect to
 4 what gas ratepayers actually pay, then the comparison of NPVs would be correct. But this cannot
 5 and should not be the case. Otherwise, one could add a billion dollars to what gas ratepayers pay
 6 under PG&E’s proposal and the proposal could still be deemed “cost effective.”

7 PG&E seems to think that an increase in rates is a “financial benefit”¹⁴ to gas ratepayers
 8 and that it “promotes long-term gas ratepayer affordability.”¹⁵ If that is the case, perhaps PG&E
 9 can benefit gas ratepayers even more by arbitrarily adding a billion dollars to each gas
 10 customer’s bill. If gas ratepayers are to bear any of the costs of this proposal from PG&E, or

¹³ Indicated Shippers, p. 3-4.

¹⁴ PG&E Amended Testimony, p. 1-2:19-22.

¹⁵ PG&E Amended Testimony, p. 1-2:1-7. Though PG&E shows that its proposal increases gas ratepayer revenue requirements, PG&E bizarrely says “it is our hope that this decarbonization non-pipeline alternative project, called the CSU Decarbonization Project, can serve as a case study in how a utility can use building decarbonization as a tool to both reduce emissions and promote long-term gas ratepayer affordability through a reduction in utility revenue requirements.” PG&E’s calculation of revenue requirements show exactly the opposite.

1 indeed any electrification proposal, the Commission should judge its cost effectiveness by
2 whether gas ratepayers pay less in rates under electrification than they would otherwise.

3 **IV. AS A TRANSACTION BETWEEN GAS RATEPAYERS AND CSU**
4 **MONTEREY BAY, PG&E'S PROPOSAL IS A LOUSY DEAL FOR**
5 **RATEPAYERS**

6 PG&E seems to argue that its proposal provides benefits to gas ratepayers so it is a good
7 deal that they should accept. Setting aside for a moment whether PG&E's estimates of the costs
8 and benefits of its proposal are accurate, or even whether its use of NPV versus PVRR is correct,
9 it is clear, as discussed above, that PG&E's proposal is a terrible deal for gas ratepayers. Under
10 PG&E's proposal, gas ratepayers get only 6.5 cents on the dollar of the benefits. 93.5 percent of
11 the benefits go to CSU Monterey Bay. PAO suggests that CSU Monterey Bay pay only a small
12 portion of the costs, 10 percent, leaving the arrangement still very lopsided.¹⁶

13 Just as with your friend in the park, a reasonable *starting* point would be a fifty-fifty split
14 of the benefits between gas ratepayers and CSU Monterey Bay. But, as discussed below, the risk
15 characteristics of the proposal mean that gas ratepayers should get more than fifty percent of any
16 benefits.

17 In putting forth its proposal, PG&E has not acted in the interests of its gas ratepayers.
18 Indeed, it is clear that PG&E's own interests in the CSU Monterey Bay electrification conflict
19 with those of its gas ratepayers. PG&E requests treatment of the cost of electrification as a
20 regulatory asset to be included in gas rates.¹⁷ Any costs of electrification that CSU Monterey Bay
21 would pay under a reasonable arrangement for gas ratepayers would very likely not get

¹⁶ PAO Opening Testimony, p. 3:17-19.

¹⁷ Amended Application, p. 3.

1 regulatory asset treatment. CSU has an endowment of \$2.3 billion¹⁸ with an annual budget of
2 \$8.1 billion including an annual maintenance and operation of plant budget of \$1.0 billion.¹⁹ It
3 would be very surprising if CSU agreed to pay PG&E a rate of return for its share of the costs of
4 electrification.

5 In other words, PG&E would only earn a rate of return on the portion of the cost of
6 electrification borne by ratepayers. As such, PG&E has no incentive to negotiate a deal with
7 CSU Monterey Bay to pay some of the electrification costs. So, it is not surprising that PG&E
8 apparently did not try very hard to get a contribution from CSU Monterey Bay. Though CSU
9 Monterey Bay asked for cost estimates, PG&E did not provide any.²⁰

10 Again, a reasonable *starting* point for the sharing of the costs of electrification is a 50/50
11 split between gas ratepayers. However, a 50/50 split gives too much to CSU Monterey Bay. It is
12 not clear from PG&E's testimony who bears the risk of costs of electrification exceeding its
13 estimates. This is especially concerning given that PG&E states that the NPV analysis does not
14 include "any escalation factors, contingency factors, or increase in material costs due to the
15 Coronavirus pandemic."²¹ If gas ratepayers are to bear the risk of costs exceeding the estimate,
16 the ratepayers' share of the savings should be much larger than 50%.

17 **V. PG&E'S CALCULATION OF BENEFITS LEAVES OUT CRUCIAL**
18 **COMPONENTS AND THEREFORE SHOULD BE REJECTED**

19 PG&E's calculation leaves out two crucial components that make their proposal a non-
20 starter. First, PG&E's calculation does not include the increased rates paid by gas ratepayers

¹⁸ <https://www.calstate.edu/impact-of-the-csu/student-success/philanthropic-support/Pages/default.aspx>

¹⁹ "Operating Budget: 2022-23," California State University, p. 9. <https://www.calstate.edu/csu-system/about-the-csu/budget/2022-23-operating-budget>

²⁰ TURN, p. 7:14 - 8:3.

²¹ PG&E Amended Testimony, p. 2-4:7-9.

1 because the CSU Monterey Bay gas ratepayers will no longer be gas customers. Second, there
2 are numerous elements of risk and potential additional costs that are not addressed in PG&E’s
3 proposal.

4 **A. PG&E Does Not Include Increased Costs to Gas Ratepayers from the Death**
5 **Spiral**

6 Indicated Shippers correctly critiques PG&E’s analysis for not taking into account the
7 “contribution to fixed costs lost and then borne by PG&E’s remaining gas ratepayers.”²² As
8 discussed below, repeated over and over because of electrification, this could lead to the “death
9 spiral” with a shrinking base of customers paying for the gas utility’s fixed costs.²³

10 Even though only 620 units are involved in PG&E’s proposal, the potency of the death
11 spiral can be illustrated through a few simple calculations.²⁴ The average residential annual
12 PG&E gas bills for 2023 will include \$666.48 in non-commodity costs.²⁵ If only 20 percent²⁶ of
13 those non-commodity costs are fixed costs including costs of maintenance of the remaining gas
14 system, then the NPV of the costs borne by the remaining ratepayers exceeds one million
15 dollars,²⁷ the supposed benefit to gas ratepayers from PG&E’s proposal.

16 The Commission should require cost effectiveness analyses of all electrification projects
17 to include death spiral costs, the cost burden for fixed costs shifted to the remaining gas
18 ratepayers.

²² Indicated Shippers, p. 3-5:1-3-6:2.

²³ EDF also discusses the death spiral. EDF Opening Testimony, p. 3:12-4:5.

²⁴ Data from PG&E Rate Sheet attached as Appendix A.

²⁵ Monthly average for 2023 $\$55.29 \times 12 \text{ months} = \663.48 .

²⁶ Twenty percent may be a conservative estimate. One study suggests that “...a ten percent decrease in residential customers decreasing revenues by only about five percent.” “Who Will Pay for Legacy Utility Costs?”, Lucas Davis and Catherine Hausman, Journal of the Association of Environmental and Resource Economist, 9(6):1047-1085, 2022.

²⁷ $PV(0.07, 35,620 \times 663.43 \times 0.2) = -\$1,065,144$.

1 **B. PG&E Does Not Take into Account the Risks that Gas Ratepayers Bear Under**
2 **its Proposal**

3 There are many risks that PG&E does not take into account in its proposal in
4 consideration of cost effectiveness. As Indicated Shippers points out, PG&E’s analysis does not
5 have contingencies for risks.²⁸ Amongst the risks that PG&E should have included in its analysis
6 through the use of contingencies or sensitivities are:

- 7 1. The timing and structure of the various project phases.²⁹
- 8 2. The cost of electric system upgrades which TURN believes may be needed.³⁰
- 9 3. Variable contractor and material costs.³¹
- 10 4. Litigation risk and costs. CSU Monterey Bay “believes existing contracts with the
11 66 homeowners would allow CSU Monterey Bay to be able to legally cease gas
12 service with affected customers.”³² As PG&E knows from wildfire litigation,
13 litigation can be very expensive and uncertain. Calculations of cost effectiveness
14 should not assume away litigation costs, in this case, by trusting assertions by
15 CSU Monterey Bay.

16 Without conducting sensitivities or including contingencies in cost estimates, PG&E’s
17 NPV and PVRR calculations are not useful. A 1.067 cost-benefit ratio³³ gives no room for error,
18 and should not be accepted by the Commission as a showing that the proposal shows a positive
19 NPV.

²⁸ Indicated Shippers, p. 3-2:2-6.

²⁹ TURN, p. 5:14-16. Indicated Shippers, p. 3-2:16-19.

³⁰ TURN, Opening Testimony, p. 4:16-19.

³¹ Indicated Shippers, p. 3-2:2-6.

³² PG&E Amended Testimony, p. 1-4 – 1-5.

³³ Indicated Shippers, p. 3-2:7-13

1 The Commission should require all electrification proposals to include contingencies and
2 sensitivities in their cost effectiveness analysis.

3 **VI. TO AVOID THE DEATH SPIRAL ELECTRIFICATION PROJECTS**
4 **MUST HELP GAS CUSTOMERS NOT HURT THEM AS IN PG&E’S**
5 **PROPOSAL**

6 Unless California decarbonizes wisely, a shrinking number of customers will end up
7 having to support PG&E’s gas rate base leading to an unstable death spiral. As Gridworks put it,
8 “[w]idespread residential electrification could threaten California’s gas delivery systems with the
9 beginning of an industry ‘death spiral,’ in which rate increases drive more customers to exit the
10 system via electrification or other alternatives, leading to further rate increases to make up the
11 lost revenue, and so on.”³⁴ The impact will fall particularly hard on those least able to switch
12 away from gas, including renters and low-income residents.³⁵

13 While PG&E would like to put forth its proposal as a “model” for future electrification
14 projects,³⁶ it has missed the mark. A better proposal could have substantially decreased future
15 costs to ratepayers. Instead, PG&E’s proposal puts gas ratepayers at further risk and does not
16 share the costs equitably. By proposing a deal that is unfair to gas ratepayers, increases their
17 rates, and puts them at further risk for loss, PG&E’s proposal increases the likelihood of a death
18 spiral that will hurt vulnerable gas ratepayers. PG&E’s proposal for gas ratepayers to pay for
19 CSU Monterey Bay’s electrification should be rejected.

20 **VII. CONCLUSIONS**

21 1. PG&E’s proposal should be rejected as currently formulated.

³⁴ “California’s Gas System in Transition,” Gridworks, p. 4.

³⁵ “The Challenge of Retail Gas in California’s Low-Carbon Future,” E3, 2020, p. iii.

³⁶ Amended Application, p. 5.

Rebuttal Testimony of Robert Earle

- 1 2. Electric ratepayers should bear the costs of electrification, not gas ratepayers.
- 2 3. If gas ratepayers bear any cost of electrification, the correct measure of cost
- 3 effectiveness for gas ratepayers is PVRR, not NPV.
- 4 4. The calculation of cost effectiveness for gas ratepayers should include the costs
- 5 borne by remaining gas ratepayers (death spiral costs) and contingencies and
- 6 sensitivities for risks.
- 7 5. To the degree that gas ratepayers bear any cost of electrification, the splitting of
- 8 costs between gas ratepayers and other parties should be what would occur in an
- 9 arms-length transaction between two equal parties.

ATTACHMENT A

Pacific Gas and Electric Company

**Residential Average Gas Rate ^{1/} (\$/therm)
and**

Residential Average Gas Bill ^{1/} (per month)

March 2023 Forecast

Average Rate ^{2/} (\$/therm)	Jan-21	Feb-21	Mar-21 ^{3/}	Apr-21 ^{4/}	May-21 ^{4/}	Jun-21 ^{4/}	Jul-21 ^{4/}	Aug-21 ^{4/}	Sep-21 ^{4/}	Oct-21 ^{4/}	Nov-21 ^{4/}	Dec-21 ^{4/}	Average 2021
Procurement ^{3/}	\$0.49	\$0.49	\$0.42	\$0.22	\$0.21	\$0.22	\$0.19	\$0.23	\$0.44	\$0.68	\$0.81	\$0.83	\$0.44
Transportation & PPP	\$1.32	\$1.32	\$1.44	\$1.44	\$1.44	\$1.45	\$1.45	\$1.45	\$1.45	\$1.45	\$1.44	\$1.44	1.42
Total ^{4/}	\$1.81	\$1.81	\$1.86	\$1.67	\$1.65	\$1.66	\$1.64	\$1.67	\$1.89	\$2.13	\$2.25	\$2.26	\$1.86
Actual Avg Use (therm) ^{5/}	63	55	44	27	20	16	15	15	15	22	37	64	33

Average Bill Per Month ^{2/}

Procurement ^{3/}	\$31.08	\$26.99	\$18.62	\$6.02	\$4.21	\$3.48	\$2.87	\$3.38	\$6.66	\$14.99	\$30.05	\$52.84	\$16.77
Transportation & PPP	83.18	72.62	63.21	39.00	28.89	23.14	21.69	21.69	21.69	31.81	53.21	92.04	46.01
Total ^{4/}	\$114.26	\$99.61	\$81.82	\$45.02	\$33.10	\$26.62	\$24.56	\$25.07	\$28.35	\$46.80	\$83.26	\$144.88	\$60.73
(Calif. Natural Gas Annual Climate Credit for Residential Customers in April 2021 Bill Cycle)													
Net Average April Bill after GHG Credit													

Average Rate ^{2/} (\$/therm)

	Jan-22 ^{6/}	Feb-22 ^{6/}	Mar-22 ^{6/}	Apr-22 ^{6/}	May-22 ^{6/}	Jun-22 ^{6/}	Jul-22 ^{6/}	Aug-22 ^{6/}	Sep-22 ^{6/}	Oct-22 ^{6/}	Nov-22 ^{6/}	Dec-22 ^{6/}	Average 2022
Procurement ^{3/}	\$0.76	\$0.73	\$0.62	\$0.53	\$0.64	\$0.69	\$0.74	\$0.62	\$0.80	\$0.90	\$0.94	\$0.98	\$0.75
Transportation & PPP	1.60	1.60	1.60	1.61	1.61	1.61	1.61	1.65	1.65	1.65	1.62	1.62	1.62
Total ^{4/}	\$2.36	\$2.33	\$2.22	\$2.14	\$2.25	\$2.31	\$2.35	\$2.27	\$2.45	\$2.55	\$2.56	\$2.60	\$2.37
Actual Avg Use (therm) ^{5/}	64	51	36	27	20	15	14	14	14	20	51	67	32

Average Bill Per Month ^{2/}

Procurement ^{3/}	\$48.86	\$37.44	\$22.24	\$14.18	\$12.76	\$10.41	\$10.30	\$8.66	\$11.25	\$18.00	\$47.93	\$65.69	\$25.64
Transportation & PPP	102.34	81.56	57.57	43.55	32.26	24.19	22.58	23.10	23.10	32.99	82.71	108.66	52.88
Total ^{4/}	\$151.20	\$119.00	\$79.81	\$57.73	\$45.02	\$34.61	\$32.88	\$31.76	\$34.35	\$50.99	\$130.65	\$174.35	\$74.54
(Calif. Natural Gas Annual Climate Credit for Residential Customers in April 2022 Bill Cycle)													
Net Average April Bill after GHG Credit													

Forecast >

Average Rate ^{2/} (\$/therm)	Jan-23 ^{10/}	Feb-23 ^{11/}	Mar-23 ^{11/}	Apr-23 ^{11/}	May-23 ^{11/}	Jun-23 ^{11/}	Jul-23 ^{11/}	Aug-23 ^{11/12/}	Sep-23 ^{11/12/13/}	Oct-23 ^{11/12/13/}	Nov-23 ^{11/12/13/}	Dec-23 ^{11/12/13/}	Average 2023
Procurement ^{3/}	\$1.37	\$1.45	\$0.80	\$0.47	\$0.40	\$0.41	\$0.41	\$0.46	\$0.46	\$0.50	\$0.64	\$0.74	\$0.68
Transportation & PPP	1.55	1.55	1.55	1.57	1.57	1.57	1.57	1.57	2.19	2.19	2.16	2.16	1.77
Total ^{4/}	\$2.92	\$2.99	\$2.35	\$2.04	\$1.97	\$1.98	\$1.98	\$2.03	\$2.65	\$2.69	\$2.79	\$2.90	\$2.44
Forecast Avg Use (therm) ^{5/}	67	50	38	27	18	13	12	12	13	18	39	66	32

Average Bill Per Month ^{2/}

Procurement ^{3/}	\$91.83	\$72.27	\$30.49	\$12.59	\$7.23	\$5.34	\$4.96	\$5.49	\$6.00	\$8.97	\$24.78	\$49.14	\$26.59
Transportation & PPP	103.73	77.41	58.83	42.43	28.29	20.43	18.86	18.81	28.49	39.45	84.20	142.50	55.29
Total ^{4/}	\$195.56	\$149.68	\$89.32	\$55.03	\$35.52	\$25.77	\$23.82	\$24.30	\$34.49	\$48.42	\$108.98	\$191.64	\$77.48
(Calif. Natural Gas Annual Climate Credit for Res Customers in March 2023 Bill Cycle - Estimated)													
Net Average April Bill after GHG Credit - Estimated													

^{1/} Average Rate and Bill based on Non-Care Class Average, including PPP surcharges. Individual customers' bills will vary depending on actual use.

^{2/} CARE Customers receive a 20% Discount (80% of average rate or average bill).

^{3/} Procurement rate includes cost of gas commodity and transportation to the Citygate (PG&E's local transmission system).

^{4/} Totals may not sum exactly due to rounding.

^{5/} Actual and forecast usage is based on Rate Schedule G-1. Availability of actual usage data is lagged 2 months. Forecast usage is based on normal weather.

^{6/} March 2021 reflects the 2020 General Rate Case, D. 20-12-005.

^{7/} The procurement rate and bill includes a charge of \$1.92099 per therm to reflect account balance amortizations in accordance with Advice Letter (AL) 3157-G.

^{8/} January 2022 reflects the following applications: The Wildfire Expense Memorandum Account WEMA, (D.21-10-022); Residential Uncollectibles Balancing Account (RUBA) (AL-4334-G/G-A); Risk Transfer Balancing Account (RTBA) associated with 2021 Liability Insurance Costs (GRC D.20-12-005).

^{9/} April 2022 reflects a reduction to the Residential Uncollectibles Balancing Account for the California Arrears Payment Plan (CAPP) funding.

^{10/} August 2022 reflects the following approved decisions: 2019 GT&S Audit (D.22-07-007) and Risk Transfer Balancing Account RTBA (AL-4584-G) and Pension (AL-4568-G-A).

^{11/} January 2023 assumes 2022 GRC and GTS revenue requirements, 2023 Cost of Capital (D.22-12-031) and a forecast of end of year balancing accounts.

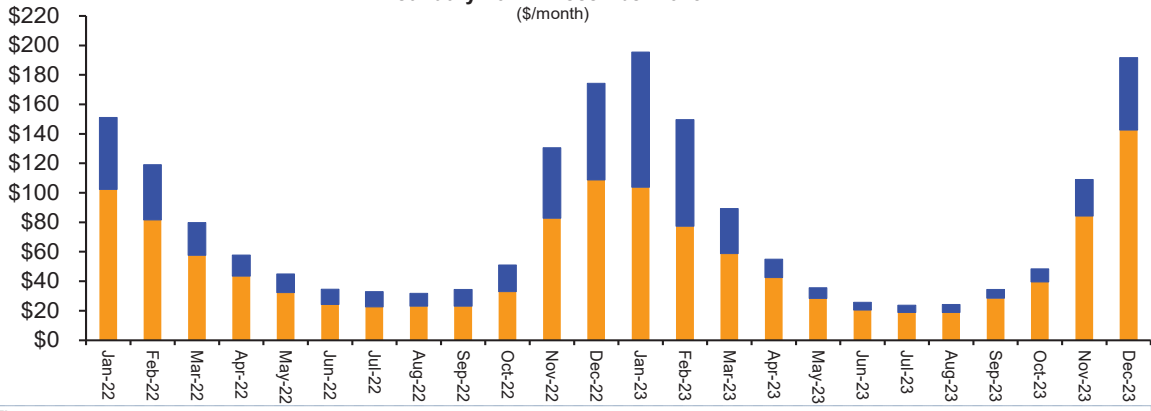
^{12/} August 2023 assumes a reduction for the 2011-2014 Capital Expenditures Audit as approved in Decision 22-07-007 and AL-4639-G. It also includes the following pending applications: 2020 Wildfire Mitigation Catastrophic Event (WMCE) (A.20-09-019) and 2021 Wildfire Mitigation Catastrophic Event WMCE (A.21-09-008).

^{13/} September 2023 assumes implementation of the 2023 GRC (A.21-06-021) with recovery for the January through August amount spread over the remainder of 2023 and 2024, and 2023 GRC Phase I, Track II, with recovery over 24 months. GTS CARD is assumed to be implemented 1/1/2024.

Seasons: Winter = Nov-Mar Summer = April-Oct

Rate forecast is based on Management's estimates regarding gas rate components, including adjusted forward prices for gas commodity as of January 31, 2023. The rate forecast and estimates on which it is based are subject to change. Rate represents class average volumetric equivalent of charges.

Pacific Gas and Electric Company
Average Residential Gas Bills
January 2022 - December 2023*
(\$/month)

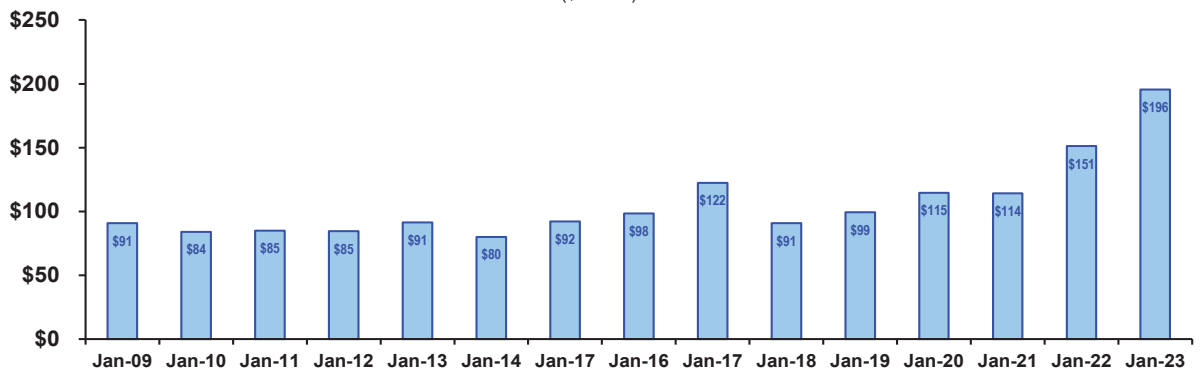


Therms
(Actual Use/Forecast Use)
64 51 36 27 20 15 14 14 14 20 51 67 67 50 38 27 18 13 12 12 13 18 39 66

■ Transportation and PPP
■ Procurement

*Rate forecast is based on Management's estimates regarding gas rate components, including adjusted forward prices for gas commodity as of January 31, 2023. The rate forecast and estimates on which it is based are subject to change. Rate represents class average volumetric equivalent of charges. Gas Public Purpose Program (PPP) mandated gas social programs. Bills based on Rate Schedule G-1 average use.
**See Residential Forecast 2021_2022_2023 tab for important details on footnotes.

**Pacific Gas and Electric Company
Residential Average January Gas Bills
2009 - 2023***
(\$/month)



Therms	74	73	74	74	85	64	62	67	76	58	62	59	63	64	67
(Actual Use/Forecast Use)															

*Rate forecast is based on Management's estimates regarding gas rate components, including adjusted forward prices for gas commodity as of January 31, 2023. The rate forecast and estimates on which it is based are subject to change. Rate represents class average volumetric equivalent of charges. Gas Public Purpose Programs (PPP) mandated gas social programs. Bills based on Rate Schedule G-1 average use. See Residential Forecast 2021_2022_2023 tab for important details on footnotes.

**Pacific Gas and Electric Company
Residential Average Winter Gas Bills
[2009 - 2023* Nov-Mar]
(\$/month)**



*Rate forecast is based on Management's estimates regarding gas rate components, including adjusted forward prices for gas commodity as of January 31, 2023. The rate forecast and estimates on which it is based are subject to change. Rate represents class average volumetric equivalent of charges. Gas Public Purpose Programs (PPP) mandated gas social programs. Bills based on Rate Schedule G-1 average use. See Residential Forecast 2021_2022_2023 tab for important details on footnotes.

ATTACHMENT B

ROBERT EARLE, PH.D.

Dr. Earle is an economist with extensive experience in the energy, telecomm, and finance sectors including valuation, environmental mitigation methods and costs, and regulatory economics. Having worked as a consultant as well as an industry manager, he currently supports clients in analyzing market opportunities, strategy, regulatory issues, and litigation. His areas of expertise include electric power sector modeling, economics of environmental mitigation, electric power and gas markets, regulatory policy and ratemaking, demand response, and system optimization.

Dr. Earle has also worked extensively on tariff and market design, including as an expert witness before a number of regulatory commissions. He was the architect of an economic model used to evaluate alternative methods for environmental mitigation including BPM/BACT technology, incentives, and markets. Results from this work were used in numerous studies for investment decisions, policy studies, and litigation. He also served as part of the study team and report writing groups for the National Petroleum Council study on the development of natural gas resources.

Dr. Earle was manager of economic analysis at the California Power Exchange where his responsibilities included developing an overall analytic infrastructure for market analysis, analysis of new products, and briefing regulatory and legislative bodies. Dr. Earle holds Ph.D. and M.S. degrees in Operations Research, both from Stanford University.

EDUCATION

- Ph.D. Operations Research, Stanford University
- M.S. Operations Research, Stanford University
- A.B. Mathematics, the College of William & Mary

REPRESENTATIVE PAST EXPERIENCE

Electricity Sector Structure and Regulation

- Advised in the development of transmission strategy for several renewables companies in the United States and Canada (wind and biomass) including analysis of transmission access, planning, cost allocation and siting conditions in regions in North America.
- Developed transmission pricing structure for Saudi Electric Company.
- Advised clients in Canada, the Middle East, and the United States on transmission pricing structures.
- Conducted numerous demand response potential and valuation studies for utilities across the United States.
- Analyzed energy efficiency potential in the Southeast for environmental and ratepayer advocates.
- Provided expert testimony on energy efficiency incentives for Oklahoma Gas & Electric.
- Led analysis for Midwest ISO of wholesale market interface with demand response.

Bidding/Auction Design and Analysis, Market Modeling

- Conducted detailed studies of participant bidding behavior for the purpose of product development, policy changes, and investigations. The results of these studies were used to establish standard methodologies for staff to use. In addition, Dr. Earle invented new techniques for characterizing bids to examine product ideas and various alternative market structures.
- Led the development of a new type of multivariate statistical model to track market changes and rigorously assess auction participant behavior. Reflecting the auction structure, this model uniquely codetermined all prices at the same time. To do this, a number of new statistical techniques were created.
- Advised two merging companies needing advice on divestiture of their generation assets with respect to both asset value and issues of strategic behavior. For this purpose, Dr. Earle designed and implemented an oligopoly simulation of the market. This game theoretic model explicitly represents company strategies and interactions in the marketplace. Dr. Earle's findings were used to shape the decisions of the investment bank in selling the merged companies' assets and win regulatory approval.

Environment

- Architect of economic model used to evaluate alternative methods for environmental mitigation including BPM/BACT technology, incentives, and markets. Results from this work were used in numerous studies for investment decisions, policy studies, and litigation.
- Advised clients on approaches to environmental mitigation in the oil, electric power, and water sectors.
- Managed a 2-year project to develop a carbon mitigation strategy for a major country in the Middle East.
- Managed a successful water privatization for a city of five million where environmental concerns formed a key part of the privatization effort.

Valuation of Assets, Market Strategies

- For the Electric Power Research Institute (EPRI), developed a methodology for the valuation of alternative market strategies for hydroelectric power plants using stochastic dynamic programming. The changing dynamics of the electricity market, in particular the structure of electricity prices, may have significant implications for the value of a technology that can store energy and release it according to market conditions, thereby leading to a premium value for such resources. The methodology Dr. Earle developed was published in an EPRI report.
- Assessed the impact of market structure changes on plant value that resulted in the restructuring of a bid for generation assets.
- As a result of reorganization, a utility company needed help in valuation of its load management technology and program. At the time, its program was one of the top five in the United States. Dr. Earle directed a team to conduct market research on this technology and teach a class on its current status. As a follow-on, Dr. Earle acted as a facilitator to the client in their development of a valuation methodology. This project resulted in the client deciding to phase-out its efforts in this area.

Corporate Strategy

- In preparation for deregulation of the generation sector in the power industry, Dr. Earle co-led a team to formulate valuation and corporate asset deployment strategies for a \$5 billion southeastern utility. The various options considered included: asset spin-off, divestiture, mergers, and acquisitions.

Different scenarios implied different trade-offs among the business units of the company. This required extensive financial modeling of the various options and sensitivity to the client's cultural issues in order to reach a unified decision. These recommendations were adopted by the board as the basis for ongoing company strategy.

- Conducted market research for a company that was considering starting an energy brokerage in California. Key issues investigated were market size and structure, first mover advantage, and risk. As a result of this work, the company selected an effective start-up strategy for its new operation in California.
- Reporting to the CEO, co-negotiated a settlement calculation involving a billion dollars. Co-wrote the filing implementing the settlement and then coordinated its implementation through the IT and settlements process.

EXPERT TESTIMONY

- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the Pacific Gas & Electric 2023 General Rate Case.
- Before the Washington Utilities and Transportation Commission, on behalf of the Attorney General of the State of Washington, concerning the Avista 2023 General Rate Case.
- Before the Washington Utilities and Transportation Commission, on behalf of the Attorney General of the State of Washington, concerning the Puget Sound Energy 2023 General Rate Case.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning Major Updates to the 2022 Avoided Cost Calculator.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the rulemaking to revisit net energy metering tariffs.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the issuance of recovery bonds for Pacific Gas & Electric.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning Southern California Edison's Application for Wildfire Cost Securitization.
- Before the Washington Utilities and Transportation Commission, on behalf of the Attorney General of the State of Washington, concerning power costs and interjurisdictional allocation in the PacifiCorp 2021 General Rate Case.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the Southern California Edison 2021 General Rate Case.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning Major Updates to the 2020 Avoided Cost Calculator.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the Pacific Gas & Electric Gas 2020 General Rate Case.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the Pacific Gas & Electric Gas Transmission and Storage Rate Case.
- Before the California Public Utilities Commission, on behalf of the Coalition of California Utility Employees, concerning the Power Charge Indifference Adjustment.
- Before the Ohio Public Utilities Commission, on behalf of FirstEnergy, concerning the market for renewable energy credits.

- Before the District Court in Dallas, Texas, on behalf of O Mart, submitted an expert affidavit concerning the appropriate method to value a breach of an electric power purchase contract.
- Before the Superior Court of California in Los Angeles County, on behalf of several municipal utilities, submitted two expert reports on the structure of California electricity markets and on certain transactions in the California electricity marketplace.
- Before the Oklahoma Corporation Commission, on behalf of Oklahoma Gas & Electric, concerning cost recovery and shareholder incentives for DSM programs.
- Before the Public Utilities Commission of Texas, on behalf of El Paso Electric, concerning the capacity value of certain electric power contracts in a fuel cost reconciliation proceeding.
- Before the Federal Energy Regulatory Commission, on behalf of El Paso Electric, concerning the effect of certain power market transactions on California and western markets and the effect of information sharing on California markets.
- Before the New Brunswick Public Utilities Board, on behalf of J.D. Irving, Ltd. and the Canadian Manufacturers and Exporters, concerning the transmission tariff application by New Brunswick Power.

PUBLICATIONS AND PRESENTED PAPERS

“Tail of the Corona Virus?: High Stakes Decisions with Little Information – A Case Examining Data Leadership,” with Jung Park and Karl Schmedders, February 2021.

“Attack of zombie companies: don’t let them eat bailouts that are vital to restore the economy,” with Jung Park and Karl Schmedders, *the Conversation*, June 2, 2020, republished in *The National Interest*.

“Coronavirus: the economic recovery won’t only be U-shaped – it’ll look like a wheelbarrow,” with Jung Park and Karl Schmedders, *the Conversation*, April 14, 2020, republished in *World Economic Forum Agenda* and *The National Interest*.

“Spectrum Auctions Around the World: An Assessment of International Experiences with Auction Restrictions”, with David W. Sosa, July 2013, prepared for Mobile Future.

“Hydraulic Fracturing: the regulatory year in review,” *Oil and Gas Financial Journal*, January 2012, Vol. 9, No. 1.

“How not to improve surface water quality,” with Virginia Perry-Failor, *Regulation*, Fall 2010, Cato Institute Press.

“The Costs of Compliance to EPA’s Advance Notice of Proposed Rulemaking on the PCB Use Authorization for Interstate Natural Gas Pipelines,” with Susan Tierney, prepared on behalf of the Interstate Natural Gas Association of America (“INGAA”), September 10, 2010.

“Demand Response on Steroids: Extra Value from using the Smart Grid?,” *Natural Gas and Electricity*, February 2010.

“Measuring the Capacity Impacts of Demand Response,” with Ed Kahn and Edo Macan, *Electricity Journal*, June 2009.

“Ethanol 2.0,” with Ahmad Faruqui, *Regulation*, Winter 2008, Cato Institute Press.

“Fostering Economic Demand Response in the Midwest ISO,” with Sam Newell, Ahmad Faruqui, Attila Hajos, and Ryan Hledik, prepared for the Midwest ISO, December 30, 2008.

“Transforming America’s Power Industry: The Investment Challenge 2010-2030,” with Mark Chupka, Peter Fox-Penner, and Ryan Hledik, prepared for the Edison Foundation, November 2008.

“The Role of Expectations in Modeling Costs of Climate Change Policies,” with Paul Bernstein and David Montgomery, to appear in *Integrated Assessment of Human-induced Climate Change*, Cambridge University Press, 2007.

“On Price Caps under Uncertainty,” with Karl Schmedders and Tymon Tatur, *Review of Economic Studies*, January 2007.

“Demand Response and Advance Metering,” with Ahmad Faruqi, *Regulation*, The Cato Institute, Spring 2006.

“Toward a New Paradigm for Valuing Demand Response,” with Ahmad Faruqi, *The Electricity Journal*, May 2006.

“Rate Case Mania,” with Ahmad Faruqi, *Public Utilities Fortnightly*, February 2006.

“Controlling the Thirst for Demand,” with Anees Azzouni and Ahmad Faruqi, *Middle East Economic Digest*, December 2, 2005.

“Reforming Electricity Pricing in the Middle East,” with Anees Azzouni and Ahmad Faruqi, *Middle East Economic Survey*, December 5, 2005.

“Ontario Demand-Supply Balance Update: Where will the hot trading occur?,” Interjurisdictional Power Transaction Conference, The Canadian Institute, Toronto, invited talk, April 8, 2002.

“Price Caps and Uncertain Demand,” with Karl Schmedders and Tymon Tatur, Discussion Paper #1340, CMS-EMS: The Center for Mathematical Studies in Economics and Management Sciences, Kellogg School of Management, Northwestern University, March 6, 2002.

“Demand Uncertainty and Risk-Aversion: Why Price Caps May Lead to Higher Prices,” with Karl Schmedders, Discussion Paper #1330, CMS-EMS: The Center for Mathematical Studies in Economics and Management Sciences, Kellogg School of Management, Northwestern University, October 2, 2001.

“Demand Elasticity in the California Day-Ahead Market,” *Electricity Journal*, October 2000.

“Electric Power Deregulation and Market Monitoring,” with Philip Q. Hanser and James D. Reitzes, *Electricity Journal*, October 2000.

“How Many Firms Are Enough?—Deregulating Electric Generation,” with Philip Q. Hanser and James D. Reitzes, Western Economic Association Conference, Vancouver, B.C., July 2000.

“Review of Price Behavior in the California Power Exchange,” Western Power Trading Forum, invited talk, May 2000.

“Electric Power Restructuring: Industrial Organization,” Department of Management and Strategy, Kellogg School of Management, Northwestern University, invited talk, April 26, 2000.

“Reply to Borenstein and Bushnell,” with Philip Q. Hanser and James D. Reitzes, *Electricity Journal*, March 2000.

“Market Power Basics,” IEEE Los Angeles Chapter, invited talk, March 14, 2000.

“Lessons from the Early Days of Competition in California,” with Philip Q. Hanser, Weldon C. Johnson, and James D. Reitzes, *Electricity Journal*, October 1999.

“Optionality in Energy and Ancillary Services Markets,” with Jason A. Hicks, Deregulation Progress Report: Issues and Insights Conference, invited talk, August 4, 1999.

“Measuring Market Power: Back to the Basics,” with Jason A. Hicks, invited talk, Deregulation Progress Report: Issues and Insights Conference, August 4, 1999.

Mechanisms for Evaluating the Role of Hydroelectric Generation in Ancillary Services Markets, with R.P. Broehm, F.C. Graves, T.J. Jenkin, and D.M. Murphy, EPRI, Palo Alto, CA: 1998. Report TR-111707.

“Power Market Price Forecasting: Pitfalls and Unresolved Issues,” with Frank C. Graves and Philip Q. Hanser, *USAEE/IAEE Annual North American Conference Proceedings*, October 1998.

“Capacity Expansion/Investment Dynamics: Price Forecasting in Deregulated Electric Power Markets,” presentation to Market Price Forecasting Conference, Baltimore, Maryland, August 25, 1998.

“Planning Reserve Requirements in a Deregulated Industry: One-Part vs. Two-Part Pricing -or- How I Learned to Stop Worrying and Love Regulation,” with Frank C. Graves and Philip Q. Hanser, presentation to ISO Operations, Planning, and Design: An MIT Energy Laboratory, Massachusetts Institute of Technology, June 10, 1998.

“One-Part Markets for Electric Power: Ensuring the Benefits of Competition,” with Frank C. Graves, Philip Q. Hanser, and E. Grant Read, in *Power Systems Restructuring: Engineering and Economics*, Marija Ilic, Francisco Galiana, and Lester Fink, eds., Kluwer Academic Publishers, Boston, 1998.

“Computation of Electric Power Production Cost with Transmission Constraints,” Energy Modeling Forum, Stanford University, EMF-SR6, December 1996.

TEACHING

Guest lecturer for Master’s level seminars, Department of Quantitative Business Administration, University of Zurich

- | | |
|-------------------------------------|-------------------------------|
| ○ Reinforcement Learning | Autumn 2017, 2018, 2019, 2020 |
| ○ Neural Networks and Deep Learning | Spring 2017, 2019, 2020, 2021 |
| ○ Machine Learning for Managers | Autumn 2016, Spring 2018 |
| ○ Methods in Economic Consulting | Autumn 2015 |

Master’s Theses Supervised:

- “Use of a Reinforcement Learning Algorithm to Search Trading Strategies for the Management of a Multi-Asset Portfolio”, Master of Arts in Banking and Finance, Colin Grab, 2018.
- “A Reinforcement Learning Approach for Airline Revenue Management,” Master of Arts in Banking and Finance, Marco Kiener, 2021 (*forthcoming*).

OTHER PROFESSIONAL ACTIVITIES

- Referee for *Journal of Regulatory Economics*, *Energy Journal*.
- Center for Research in Regulated Industries, Rutgers University, member of organizing committee for annual Western Conference, 2005 – 2015.

POSITIONS HELD

2015-present Alea IE, LLC, Owner

2009-2015 Analysis Group, Vice President

2007-2009	Brattle Group, Principal and San Francisco Office Director
2001-2007	Charles River Associates, Principal
1999-2001	California Power Exchange, Manager of Economic Analysis
1997-1999	Brattle Group, Associate