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BEFORE THE ARIZONA CORPORATION COMMISSION

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BOB BURNS
COMMISSIONER

TOM FORESE
COMMISSIONER

ANDY TOBIN
COMMISSIONER

11 **IN THE MATTER OF THE**) **DOCKET NO. E-01933A-15-0239**
12 **APPLICATION OF TUCSON**)
13 **ELECTRIC POWER COMPANY**)
14 **FOR APPROVAL OF ITS 2016**) **THE ENERGY FREEDOM COALITION**
15 **RENEWABLE ENERGY STANDARD**) **OF AMERICA'S NOTICE OF FILING**
16 **AND TARIFF IMPLEMENTATION**) **DIRECT TESTIMONY OF R. THOMAS**
17 **PLAN.**) **BEACH**

16 The Energy Freedom Coalition of America ("EFCA") hereby submits the Direct Testimony
17 of R. Thomas Beach in the above-referenced matter.

18
19 Respectfully submitted this 11th day of March, 2016.

21 Arizona Corporation Commission

22 DOCKETED

23 MAR 11 2016

24 DOCKETED BY []

21 /s/ Court S. Rich

22 Court S. Rich
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24 Attorney for EFCA

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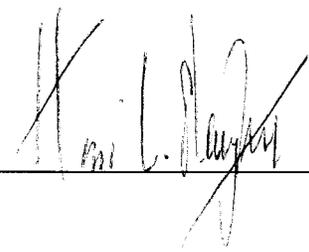
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BEFORE THE ARIZONA CORPORATION COMMISSION

**DOUG LITTLE
CHAIRMAN**

**BOB STUMP
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**IN THE MATTER OF THE
APPLICATION OF TUCSON ELECTRIC
POWER COMPANY FOR APPROVAL
OF ITS 2016 RENEWABLE ENERGY
STANDARD AND TARIFF
IMPLEMENTATION PLAN**

DOCKET NO. E-01933A-15-0239

DIRECT TESTIMONY OF R. THOMAS BEACH

Executive Summary

This testimony on behalf of the Energy Freedom Coalition of America (“EFCA”) responds to the request of Tucson Electric Power (“TEP”) for Commission approval of this Renewable Energy Standard and Tariff (“REST”) Application to expand one utility-owned residential solar distributed generation (“DG”) program and to initiate another. EFCA opposes approval of these programs.

TEP has argued that its utility-owned residential solar programs will reduce the “cost shift” to non-participating ratepayers that TEP alleges to result from residential solar DG systems installed by third parties and compensated under net energy metering (“NEM”). This testimony demonstrates that this is not true, and that the two proposed TEP-owned solar programs would cost TEP ratepayers an additional \$2.1 million per year, or \$53 million over their 25-year lives, compared to the costs of a comparable amount of “free market” solar developed under current NEM rules.

These higher costs would result for several reasons. First, TEP has set the fixed monthly prices for these programs at less than the full revenue requirements for these solar DG programs, once they are in TEP’s rate base. Second, TEP proposes to provide the subscribers to these programs with two valuable options – first, the option to use an additional 15% of the subscriber’s historical usage for free, and, second, to purchase any additional electricity beyond that initial free 15% allowance at a fixed price that does not change for 25 years. These opportunities are not available to free market solar customers under net metering, who must pay the going retail rate for every kWh that they use above the amount of power that their system provides. Further, these aspects of the TEP program give subscribers less incentive to use energy efficiently than does net metering; NEM preserves the same incentives to use energy efficiently that non-solar customers face.

We observe that TEP’s expected costs for these solar DG programs appear to be too low, because TEP has not accounted fully for all program costs. TEP’s stated program costs include only equipment, installation, and permitting costs, and TEP would charge subscribers for just a nominal amount of “incremental” administrative costs. Yet TEP clearly would use its existing, embedded administrative & general (A&G) resources to provide overhead services to these programs, has not accounted for these costs in a fully allocated manner. When these A&G costs are added, TEP’s costs for its solar programs are not different than reported costs for third-party solar installations in Arizona.

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Exhibit 1 – CV of R. Thomas Beach

1 I. INTRODUCTION / QUALIFICATIONS

2

3 **Q1: Please state for the record your name, position, and business address.**

4 A1: My name is R. Thomas Beach. I am principal consultant of the consulting firm
5 Crossborder Energy. My business address is 2560 Ninth Street, Suite 213A,
6 Berkeley, California 94710.

7

8 **Q2: Please describe your experience and qualifications.**

9 A2: My experience and qualifications are described in my *curriculum vitae*, attached
10 as **Exhibit 1**. As reflected in my CV, I have more than 30 years of experience in
11 the natural gas and electricity industries. I began my career in 1981 on the staff at
12 the California Public Utilities Commission (“CPUC”), working on the
13 implementation of the Public Utilities Regulatory Policies Act of 1978
14 (“PURPA”). Since 1989, I have had a private consulting practice on energy
15 issues and have appeared, testified, or submitted testimony on numerous
16 occasions before state regulatory commissions in Arizona, California, Colorado,
17 Idaho, Minnesota, Nevada, New Mexico, North Carolina, Oklahoma, Oregon,
18 Georgia, South Carolina, Texas, Utah, Vermont and Virginia. My CV includes a
19 list of the formal testimony that I have sponsored in various state regulatory
20 proceedings concerning electric and gas utilities.

21

22 **Q3: Please describe more specifically your experience on issues concerning solar
23 distributed generation.**

24 A3: In addition to working on the initial implementation of PURPA while on the staff
25 at the CPUC, in private practice I have represented the full range of qualifying
26 facility (“QF”) technologies – both renewable small power producers as well as
27 gas-fired cogeneration QFs – on avoided cost pricing issues before the utilities
28 commissions in California, Idaho, North Carolina, Oregon, Utah, and Nevada.
29 With respect to benefit-cost issues concerning renewable distributed generation
30 (“DG”), I have sponsored testimony on net energy metering (“NEM”) and solar
31 economics in California, Colorado, Idaho, Minnesota, New Mexico, North

1 Carolina, South Carolina, Texas, and Virginia. In the last three years, I have co-
2 authored benefit-cost studies of NEM or solar DG in Arizona (focusing on
3 Arizona Public Service ["APS"]), Colorado, North Carolina, and California. I
4 also co-authored a chapter on Distributed Generation Policy in *America's Power*
5 *Plan*, a report on emerging energy issues, which was released in 2013 and is
6 designed to provide policymakers with tools to address key questions concerning
7 distributed generation resources. I recently submitted testimony on behalf of The
8 Alliance for Solar Choice ("TASC") in Docket No. E-00000J-14-023, the
9 Commission's investigation into the value and cost of distributed generation.
10 That testimony includes an update to Crossborder's benefit/cost study of DG on
11 the APS system.

12
13 **Q4: On whose behalf are you testifying in this proceeding?**

14 A4: I am testifying on behalf of the Energy Freedom Coalition of America ("EFCA").
15
16

17 **II. BACKGROUND: TEP'S UTILITY-OWNED SOLAR PROGRAMS**
18

19 **A. TEP-Owned Residential Solar**
20

21 **Q5: Please describe briefly the first of the two utility-owned solar programs that**
22 **TEP is proposing in this docket.**

23 A5: The first program is an expansion of the TEP-Owned Residential Solar ("TORS")
24 program. The Commission's Order No. 74884 in the 2014 REST docket (Docket
25 No. E-01933A-14-0248) approved an initial phase of the TORS program as a
26 limited pilot program, and thus required TEP to obtain Commission approval for
27 any further expansion.¹ TEP is requesting that further approval in this REST
28 proceeding. The initial program was limited to 600 customers and a budget not to
29 exceed \$10 million; the utility expects to reach these limits in August 2016.² TEP

¹ Order No. 74844, at p. 18, Paragraph 70.

² TEP Testimony of Carmine Tilghman, at p. 9.

1 now seeks authority to expand the program by up to \$15 million and an additional
2 1,000 customers.³

3
4 Under the TORS program, the Company owns and operates a solar facility on a
5 customer's residential premise, and in exchange the customer receives a fixed
6 monthly bill that is roughly equivalent to their average bill today. TEP calculates
7 the size of the solar DG system (in kW) needed to meet the customer's historical
8 usage, assuming a solar DG system output of 1,900 kWh per kW annually. TEP
9 then charges the customer a fixed monthly rate of \$16.50 per kW, plus certain
10 surcharges. This rate will remain fixed for a period of 25 years. Customers are
11 allowed the option, at no additional cost, to increase their usage by as much as
12 15% above their historical usage. Thus, an average customer who uses 950 kWh
13 per month (11,400 kWh per year) would receive a 6 kW system and would pay
14 \$99 per month (6 kW x \$16.50 per kW). TEP will apply for recovery of the costs
15 of these utility-owned solar DG systems in an upcoming rate case.

16
17 TEP states that it has installed 75 TORS systems as of February 10, 2015
18 (presumably this is an error and should be 2016), with 158 pending installations
19 and a total of 344 systems in process.⁴ The utility reports that it expects to
20 average \$2.18 per watt-DC for the complete installation of TORS systems, based
21 on costs of \$0.92 per watt for panels and inverters, and average third-party
22 installation costs, including all balance-of-system costs, of \$1.26 per watt.⁵ TEP
23 personnel have also reported costs of \$2.25 per watt-DC installed in a
24 presentation at the National Renewable Energy Lab (NREL) about their initial
25 experience under the TORS program.⁶

³ 2016 REST Plan, at p. 10.

⁴ TEP Tilghman Testimony, at p. 9.

⁵ *Ibid.*, at p. 18.

⁶ See presentation at NREL by Justin Orkney of TEP, *The Real Line-Side Tap* (January 16, 016), at Slide 23. Hereafter, the "NREL Presentation." This document is available at http://www.nrel.gov/tech_deployment/pdfs/2016-01-21_utility-participation-rooftop-solar-pv-market.pdf.

1 **B. TEP-Owned Residential Community Solar Program**

2

3 **Q: Please describe the new solar program for which TEP seeks approval in this**
4 **REST application.**

5 A: This program would be similar in structure to the TORS program, except that the
6 solar generation would come from a Company-owned central station solar DG
7 facility, not from an individual solar DG system on the customer’s premises. TEP
8 proposes to spend up to \$10 million to develop a utility-scale “community” solar
9 facility with a capacity of about 5 MW that is interconnected to the Company's
10 distribution system. Again, the customer who subscribes to this Residential
11 Community Solar (“RCS”) program would have their equivalent solar capacity (in
12 kW) calculated, and would pay the utility a fixed monthly rate of \$17.50 per kW
13 to receive power from the equivalent capacity in the community solar facility.
14 Thus, a customer who uses 950 kWh per month would subscribe to 6 kW of
15 community solar capacity at a fixed monthly cost of \$105. As in the TORS
16 program, the customer would receive the free option to increase their usage by as
17 much as 15% above their historical usage. The term of the customer’s contract to
18 participate in this program would be 10 years, compared to 25 years under the
19 TORS program.⁷

20
21

22 **III. THE TRUE RATEPAYER COSTS OF THE TEP-OWNED SOLAR**
23 **PROGRAMS**

24

25 **A. The Staff’s Analysis Ignores TEP’s Rate Base Costs.**

26

27 **Q: What is TEP’s primary justification for these utility-owned solar programs?**

28 A: The utility contends that its utility-owned residential solar programs will reduce
29 the alleged “cost shift” to non-participating ratepayers, compared to residential

⁷ See TEP Tilghman Testimony, at pp. 21-22.

1 “free market” solar DG installed by third-party installers and compensated
2 through NEM.⁸

3
4 **Q: What evidence does the utility cite to show this?**

5 A: TEP points to an analysis that Commission Staff presented comparing three
6 hypothetical customers with identical electric consumption: a non-participating
7 customer, a “free market” solar customer who reduces her bill to zero, and a
8 participant in the TORS program. The Staff presented a chart showing the
9 payments made to TEP by each of these customers:

10
11 **Table 1: Staff’s Analysis (showing average monthly costs)**

	Existing, Non-solar Customer	Free market, Net-zero Customer	TORS Customer
Customer Charge	\$10.00	\$10.00	
Delivery Margin	\$20.20		
Fixed Costs	\$30.80		
Fuel Costs	\$32.00		
Monthly Payment			\$93.00
Total Monthly Payment	\$93.00	\$10.00	\$93.00

12
13 The utility recovers essentially the same revenue from the TORS customer that it
14 does from the regular, non-solar customer. TEP claims that, from the revenue
15 recovered from the TORS customer, it would apply the customer charge, delivery
16 margin, and fixed costs (totaling \$61) to its costs. Thus, the utility claims it
17 would not seek to recover these costs from other. In contrast, TEP collects only
18 the \$10 customer charge from the free market solar customer, with the other \$51
19 collected from other ratepayers. Based on this accounting, TEP argues that the

⁸ *Ibid.*, at pp. 15-17.

1 TORS program results in a shift of fewer costs to non-participating ratepayers
2 than does free market solar.⁹
3

4 **Q: What is wrong with this picture?**

5 A: The problem is that the Staff analysis completely leaves out the costs of the
6 utility-owned solar facilities, which will be recovered in TEP's future rates when
7 these facilities are added to TEP's rate base in a future rate case. The unanswered
8 questions to date concerning the TORS program are: first, what these rate base
9 costs will be; and second, whether these costs will be offset by the revenues from
10 the TORS program's subscribers at the fixed monthly rates for 25 years. For
11 example, for the TORS program, if the utility dedicates \$61 per month from these
12 revenues to its other system costs, as TEP has said that it will do, it would have
13 only \$32 per month to cover the costs of the utility-owned solar, as Mr. Tilghman
14 admits on page 16, line 26 of his testimony. The obvious problem is that \$32 per
15 month is clearly inadequate to cover the costs of the TEP-owned solar facilities.
16 The present value of 25 years of payments of \$32 per month at a 7.26% discount
17 rate (TEP's current before-tax weighted average cost of capital ["WACC"]) is
18 \$4,236, or just \$0.77 per watt for the exemplary 5.53 kW solar DG system in the
19 Staff's example. This is far below even TEP's stated solar costs of about \$2.20
20 per watt (which, as discussed further below, is unrealistically low). It is simply
21 not credible that TEP will be able to obtain residential solar at this price – this
22 does not even cover TEP's stated costs of \$0.92 per watt for the panels and
23 inverters, let alone the installation costs, the other "soft" costs for these facilities,
24 and a fully-allocated share of TEP's own A&G costs. In fact, as I will show
25 below, even the full \$93 per month in revenues from the exemplary TORS
26 customer will not cover TEP's solar costs if those costs are recovered through the
27 utility's rate base.
28
29

⁹ *Ibid.*, at pp. 16-17.

1 **Q: Does the TORS program provide any additional benefits to subscribers that**
2 **are not provided to free market solar customers under net metering?**

3 A: Yes. Under TEP's program, the TORS customers would have the option to
4 increase their usage over time by up to 15%, at no additional charge. In addition,
5 even if the TORS customer exceeds the 15% free allowance for incremental
6 power, it can purchase additional electricity at the original fixed rate at any time
7 over the 25-year period, even if TEP's rates have increased substantially
8 compared to when the customer joined the program. This fixed rate is effectively
9 10.42 cents per kWh.¹⁰ Finally, the output of a solar DG system degrades over
10 time, typically by 0.5% per year, yet the price paid by the customer under the
11 TORS program remains fixed even though the utility gradually has to replace the
12 fixed-price solar generation with more expensive system power. The value of this
13 option to obtain free or fixed-price electricity over a 25-year period from TEP is
14 significant (about \$25 per month,¹¹ as I discuss below), and is not priced into the
15 cost of the TEP programs or considered anywhere in the utility's or Staff's
16 analyses.

17
18 In contrast, a free market solar customer enjoys none of these benefits. If
19 a free market solar customer uses more power than his system produces, that
20 customer must pay TEP the full, current retail rate for every extra kWh, whatever
21 the going rate is at that time.¹² The same is true when the NEM customer must
22 replace his degraded output with utility power. As a result, the more favorable
23 terms for the TEP programs would place free market solar at a significant and
24 undue competitive disadvantage in the market.

25
26

¹⁰ $\$0.1042/\text{kWh} = (\$16.50/\text{kW-month} \times 12 \text{ months}) / 1,900 \text{ kWh} / \text{kW}$

¹¹ The value of this option to use free electricity increases over time as TEP's rates increase. As a result, to be comparable to the fixed prices for the TORS program, we calculate the value of this option on a levelized basis over 25 years, assuming 2.5% annual rate escalation and a 7.62% discount rate.

¹²

1 **Q: Do the same issues exist for the TEP-Owned Community Solar program?**

2 A: Yes. As with the TORS program, TEP has not estimated what the rate base costs
3 of the 5 MW RCS facility will be, in comparison to the revenues for the program
4 based on the proposed \$17.50 per kW cost to subscribers. The subscriber to the
5 RCS program also benefits from the option to use 15% more electricity for free,
6 the lifetime fixed price for additional power, and the protection against system
7 degradation.

8

9 **B. The Real Costs of TEP's Solar Programs Will Exceed TEP's**
10 **Revenues.**

11

12 **Q: Have you calculated the costs to ratepayers when TEP's solar programs are**
13 **placed into rate base?**

14 A: Yes. We have used a model of utility rate-based cost recovery of renewable
15 generation technologies, developed by the consultants Energy and Environmental
16 Economics (E3) for the Western Electricity Coordinating Council ("the WECC
17 Model"), of which TEP is a member.¹³ We used the WECC Model to calculate
18 TEP's 25-year revenue requirements for the TORS and RCS programs. The only
19 significant changes that we made to this model were to use TEP's current
20 financial parameters (a before-tax WACC of 7.26%) and to reduce the annual
21 O&M costs to TEP's stated 3.5 cents per watt-year (\$35 per kW-year).

22

23 **Q: What did you use as the capital costs?**

24 A: At the low end, we use TEP's stated PV costs of \$2.18 per watt-DC for the TORS
25 program, and \$1.65 per watt-DC for the RCS program.

26

27 TEP's stated costs for these programs have not included its fully allocated
28 overhead costs. For example, there are the following issues with TEP's
29 accounting for the overhead costs of the TORS program:

¹³ This *WECC Generation Costing Tool* model is available on the E3 website at
https://ethree.com/public_projects/renewable_energy_costing_tool.php.

- 1 • TEP’s testimony says that it “has not marketed” the TORS
2 program.¹⁴ Yet the utility clearly has used website resources, its
3 media contacts, and electronic newsletter to publicize the program,
4 as stated in the “Program Marketing” slide of the NREL
5 Presentation, whose title suggests that the utility has indeed
6 marketed the program. TEP has curated a lengthy list of interested
7 customers, and has developed information explaining how the
8 program works.¹⁵
9
- 10 • TEP is using the value of its reputation and goodwill to market this
11 program, as the NREL Presentation makes clear.¹⁶
12
- 13 • The utility has used its established procurement processes to
14 purchase panels and inverters, as well as its Materials Management
15 Services and a portion of a company yard to store and distribute
16 this equipment. The NREL Presentation also shows that TEP uses
17 its internal workflow management system to manage its allied
18 contractors.¹⁷
19
- 20 • TEP clearly has incurred corporate overhead expenses for
21 designing these programs, for developing customer application
22 materials, for developing, bidding, and administering the contracts
23 with its allied installers, and for securing regulatory approval for
24 the TORS program.
25
- 26 TEP does charge the customers chosen for the program a \$250 application
27 fee, to cover “incremental labor and administrative costs.”¹⁸ However, this
28 clearly does not represent a fully allocated share of TEP’s embedded general plant
29 and overhead costs, as it amounts to just \$150,000 for the initial 600 customers.
30
- 31 **Q: How would you estimate TEP’s fully allocated general plant and overhead**
32 **costs for these programs?**
- 33 **A:** TEP’s general plant averages 6.9% of its rate base, using the last four
34 years of available FERC Form 1 data (2011-2014). The Company’s
35 reported A&G expenses are about \$75 million per year, or 0.8 cents per

¹⁴ Tilghman testimony, at p.9.

¹⁵ *Ibid.*, at p. 6

¹⁶ *Ibid.*, at Slide 18.

¹⁷ See NREL Presentation, at Slides 20-21.

¹⁸ Tilghman testimony, at p. 8.

1 kWh. Typical reported customer acquisition costs in the solar industry are
 2 9% of system costs.¹⁹ Adding these to the Company's reported costs of
 3 \$2.18 per watt-DC for equipment and installation yields a total cost of
 4 \$2.85 per watt-DC for the TORS program, which is within the range of
 5 reported third-party residential PV system costs in Arizona.²⁰ Thus, we
 6 use \$2.85 per watt-DC as the high end of our range of TORS costs. For
 7 the RCS program, adding our estimate of fully allocated general plant,
 8 A&G costs, and customer acquisition costs results in a cost of \$2.20 per
 9 watt-DC, which is close to the \$2.30 per watt-DC reported by LBNL as
 10 the median cost of utility-scale solar in 2014, as shown in the following
 11 figure.²¹

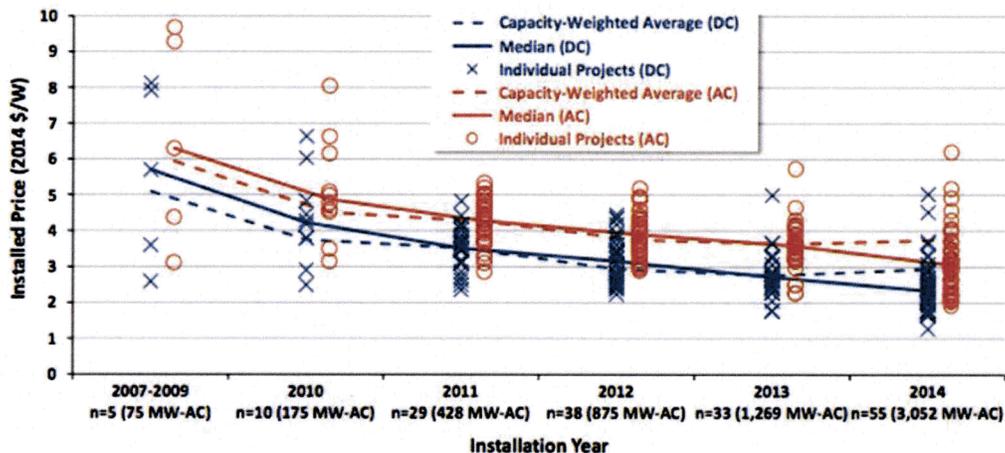


Figure 6. Installed Price of Utility-Scale PV and CPV Projects by Installation Year

12

13

¹⁹ See J. Seel, G. Barbose, and R. Wiser, *Why Are Residential PV Prices So Much Lower in Germany than in the U.S.: A Scoping Analysis* (Lawrence Berkeley National Lab, February 2013), at Slides 26 and 37, showing that customer acquisition costs (excluding system design costs) are 9.4% of total system costs. Also, B. Friedman et al., *Benchmarking Non-Hardware Balance-of-System (Soft) Costs for U.S. Photovoltaic Systems, Using a Bottom-Up Approach and Installer Survey – Second Edition* (National Renewable Energy Lab, October 13, 2013), at Table 1, showing customer acquisition costs at 9.2% of overall system costs. Available at <http://www.nrel.gov/docs/fy14osti/60412.pdf>.

²⁰ See Figure 24 in Galen L. Barbose and Naïm R. Darghouth, *Tracking the Sun VIII: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States* (LBNL, August 2015). Available at https://emp.lbl.gov/sites/all/files/lbnl-188238_2.pdf.

²¹ From Mark Bolinger and Joachim Seel, *Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States* (LBNL, September 2015). Available at <https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf>.

1 **Q: What are the rate base costs for TEP's solar programs?**

2 A: **Table 2** shows the 25-year levelized costs for the TEP solar programs if 100% of
3 the costs are found to be prudent, are placed into TEP's rate base, and are
4 recovered over 25 years under standard utility ratemaking. I show the results, in \$
5 per month, for the range of capital costs discussed above. These calculations use
6 the WECC Model of utility rate base cost recovery, with TEP's current capital
7 structure and authorized cost of capital. I have modeled a customer using 11,400
8 kWh per year, in other words, a net zero customer when served by 6 kW-AC of
9 solar capacity whose output is 1,900 kWh per kW. This is the same example
10 discussed by Mr. Tilghman and Mr. Jones in their testimony for TEP.

11
12

Table 2: Rate Base Costs for the TEP Solar Programs, for a 6 kW system

Program	Capital Cost (\$ per watt-DC)	Annual Revenue Requirement (\$/year/system)	Monthly Cost (\$/month/system)
TEP TORS Program	2.18	1,356	113
	2.85	1,688	141
TEP Community Solar	1.65	1,092	91
	2.20	1,366	114

13
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24

Thus, under both of the capital cost scenarios for the TORS program, TEP's rate base costs are higher than the \$99 per month that TEP proposes to charge a 6 kW TORS customer. The proposed charge for a 6 kW customer in the TEP RCS program – \$105 per month – falls between the two scenarios for the rate base costs for the RCS program. However, as discussed below, there are additional delivery and optionality costs that must be added to the RCS program costs. Thus, neither of the TEP solar programs will make any of the \$61 per month contribution to TEP's fixed costs that the utility touts. In fact, they will be more expensive and more burdensome for TEP's non-participating ratepayers than a comparable amount of free market, net metered solar.

1 **Q: Why does rate base treatment of TEP's solar program costs result in such**
2 **high costs for non-participating ratepayers?**

3 A: As noted by Dr. Cicchetti, the rate base for a utility generation asset depreciates
4 over the life of the asset, resulting in cost recovery that is front-loaded into the
5 early years of the asset's life. In comparison, the pricing in typical PPAs or leases
6 for renewable resources are levelized over the contract life. This difference
7 results in significantly higher costs for rate base recovery. There also can be
8 differences in the cost of capital and more favorable federal income tax benefits
9 available to independent generation companies compared to regulated utilities.
10 Generally, all else being equal, utility cost recovery through rate base is
11 significantly more expensive than merchant PPAs or leases, as a result of the
12 front-loaded cost recovery through rate base and the disparate tax benefits.

13
14 **Q: Are there additional costs for other TEP ratepayers from, first, the option**
15 **the TEP programs would provide to use 15% additional electricity for free,**
16 **and second, the guaranteed fixed price for power for 25 years?**

17 A: Yes, there are. If a TORS subscriber increases its electric consumption above the
18 historical amount on which the customer's monthly fixed price is based, the first
19 15% of additional usage is free. After that, the customer is charged the original
20 fixed energy price for further usage above the complementary first 15%, no
21 matter when in the next 25 years this extra usage occurs. These generous aspects
22 of the TEP program give subscribers less reason to use energy wisely compared to
23 NEM. NEM maintains the same incentives to use energy efficiently that a non-
24 solar customer faces.

25
26 We have compared the cost of such incremental power use by (1) a TORS
27 customer whose electricity use is originally 11,400 kWh per year and then grows
28 at 2% per year to (2) a free market NEM customer with identical electric use (also
29 growing at 2% per year) and a 6 kW net metered solar DG system. These
30 calculations assume that TEP's rates increase at the rate of inflation (2.5% per
31 year), and also consider the fact that the NEM customer must pay to replace the

1 solar output it loses to degradation, while the TORS customer does not. The
2 result is that the TORS customer will pay \$25 per month less for this incremental
3 power use than will the identical NEM customer, as a result of the TORS
4 program's 15% allowance of free electricity, its fixed-price guarantee for 25
5 years, and the fact that TORS pricing does not consider system degradation.
6

7 **Q: Are there any other costs that TEP has failed to attribute to its solar**
8 **programs?**

9 A: Yes. The output from the centralized 5 MW RCS facility will not be delivered
10 into the grid in the same location as the premises where the program's subscribers
11 will consume this power. Thus, TEP must wheel the RCS output across its
12 distribution system for delivery to subscribers at many different locations. As a
13 result of the delivery service that TEP clearly would provide to subscribers in this
14 program, TEP should include its delivery margin as a cost of the RCS program.
15 This would be consistent with the typical design of community solar programs in
16 other states, such as Colorado and California, where community solar subscribers
17 must continue to pay the utility's full delivery charges.
18

19 **Q: Can you summarize the net costs for TEP ratepayers of the two TEP-owned**
20 **solar programs and a free market solar DG system, for the same exemplary**
21 **residential customer using 11,400 kWh per year?**

22 A: Yes. This comparison is presented in **Table 3**, which includes all of the costs
23 discussed above as well as the revenues that TEP would realize from the monthly
24 charges assessed to all of these customers. The table illustrates that the TEP-
25 owned solar programs would be significantly more expensive for TEP's non-
26 participating ratepayers than if the same solar capacity were provided by an
27 existing free market solar installation under NEM.
28

29 This comparison has not considered the benefits of residential solar,
30 because I assume that all of these systems provide the same benefits. Nor do I
31 consider the lost retail rate revenues, because they are the same for each of the

1 four alternatives in Table 3. I conclude that, if there is a cost shift as a result of
2 solar DG on TEP's system, the utility's proposed utility-owned programs actually
3 would increase the cost shifts compared to a similar amount of customer-owned
4 or third-party-owned systems developed under NEM.

5
6 Table 3 also shows the potential impacts of the higher monthly customer
7 charge, the demand charges, and the lower export rate that TEP has proposed for
8 net metered solar facilities in its pending GRC (Docket No. E-01933A-15-0322).
9 The utility's GRC proposal would further reduce the ratepayer costs of net
10 metered, free market solar, but would have no impact on the ratepayer costs of the
11 utility-owned solar programs. Thus, TEP's GRC proposal would further
12 disadvantage free market solar compared to the subsidized programs for TEP-
13 owned solar that the utility has proposed.

1 **Table 3: TEP-Owned Solar Programs: Monthly Cost Comparison to Free Market Solar (25-yr levelized)**

Cost Category	Ratepayer Cost or (Benefit) of Solar Alternatives (\$ per month)			
	TEP-Owned Solar Proposals		Free Market Solar	
	UOG DG – TORS Program	UOG – Community Solar Program	Current Rates	TEP-proposed GRC Rates
TEP Rate Base Cost	\$113 - \$141 ¹	\$91 - \$114 ²		
15% Free Option / Fixed Price	\$25	\$25		
Delivery Margin		\$22		
<i>less</i> Fixed Monthly Charge	(\$99)	(\$105)	(\$10)	(\$20)
<i>less</i> Revenues from GRC-proposed Demand Charge / Low Export Rate				(\$18)
Net Ratepayer Cost or (Benefit)	\$39 - \$67	\$33 - \$56	(\$10)	(\$38)

2 ¹ From Table 2. Range reflects PV cost ranging from \$2.18 to \$2.85 per watt-DC.

3 ² From Table 2. Range reflects PV cost ranging from \$1.65 to \$2.20 per watt-DC.

1 **Q: Have you calculated the total additional costs to TEP ratepayers from the**
2 **proposed utility-owned solar programs, compared to the alternative of a**
3 **similar amount of third-party-developed, free market solar in TEP's service**
4 **territory?**

5 A: Yes, I have. Based on the costs shown in Table 3, and assuming the use of the
6 more reasonable fully allocated capital costs for the TEP-owned programs, the
7 additional costs to TEP's ratepayers for the 1,600 installations in the TORS
8 program and the 5 MW of community solar are \$2.1 million per year, or \$53
9 million over the 25-year lives of these programs.

10

11 **Q: Does this conclude your prepared direct testimony?**

12 A: Yes, it does.

Exhibit 1

Curriculum Vitae of
R. Thomas Beach

Mr. Beach is principal consultant with the consulting firm Crossborder Energy. Crossborder Energy provides economic consulting services and strategic advice on market and regulatory issues concerning the natural gas and electric industries. The firm is based in Berkeley, California, and its practice focuses on the energy markets in California, the western U.S., and Canada.

Since 1989, Mr. Beach has had an active consulting practice on policy, economic, and ratemaking issues concerning renewable energy development, the restructuring of the gas and electric industries, the addition of new natural gas pipeline and storage capacity, and a wide range of issues concerning independent power generation. From 1981 through 1989 he served at the California Public Utilities Commission, including five years as an advisor to three CPUC commissioners. While at the CPUC, he was a key advisor on the CPUC's restructuring of the natural gas industry in California, and worked extensively on the state's implementation of the Public Utilities Regulatory Policies Act of 1978.

AREAS OF EXPERTISE

- *Renewable Energy Issues:* extensive experience assisting clients with issues concerning Renewable Portfolio Standard programs, including program structure and rate impacts. He has also worked for the solar industry on rate design and net energy metering issues, on the creation of the California Solar Initiative, as well as on a wide range of solar issues in many other states.
- *Restructuring the Natural Gas and Electric Industries:* consulting and expert testimony on numerous issues involving the restructuring of the electric industry, including the 2000 - 2001 Western energy crisis.
- *Energy Markets:* studies and consultation on the dynamics of natural gas and electric markets, including the impacts of new pipeline capacity on natural gas prices and of electric restructuring on wholesale electric prices.
- *Qualifying Facility Issues:* consulting with QF clients on a broad range of issues involving independent power facilities in the Western U.S. He is one of the leading experts in California on the calculation of avoided cost prices. Other QF issues on which he has worked include complex QF contract restructurings, standby rates, greenhouse gas emission regulations, and natural gas rates for cogenerators. Crossborder Energy's QF clients include the full range of QF technologies, both fossil-fueled and renewable.
- *Pricing Policy in Regulated Industries:* consulting and expert testimony on natural gas pipeline rates and on marginal cost-based rates for natural gas and electric utilities.

EDUCATION

Mr. Beach holds a B.A. in English and physics from Dartmouth College, and an M.E. in mechanical engineering from the University of California at Berkeley.

ACADEMIC HONORS

Graduated from Dartmouth with high honors in physics and honors in English.
Chevron Fellowship, U.C. Berkeley, 1978-79

PROFESSIONAL ACCREDITATION

Registered professional engineer in the state of California.

EXPERT WITNESS TESTIMONY BEFORE THE CALIFORNIA PUBLIC UTILITIES COMMISSION

1. Prepared Direct Testimony on Behalf of **Pacific Gas & Electric Company/Pacific Gas Transmission** (I. 88-12-027 — July 15, 1989)
 - *Competitive and environmental benefits of new natural gas pipeline capacity to California.*
2.
 - a. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (A. 89-08-024 — November 10, 1989)
 - b. Prepared Rebuttal Testimony on Behalf of the **Canadian Producer Group** (A. 89-08-024 — November 30, 1989)
 - *Natural gas procurement policy; gas cost forecasting.*
3. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (R. 88-08-018 — December 7, 1989)
 - *Brokering of interstate pipeline capacity.*
4. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (A. 90-08-029 — November 1, 1990)
 - *Natural gas procurement policy; gas cost forecasting; brokerage fees.*
5. Prepared Direct Testimony on Behalf of the **Alberta Petroleum Marketing Commission and the Canadian Producer Group** (I. 86-06-005 — December 21, 1990)
 - *Firm and interruptible rates for noncore natural gas users*

6.
 - a. Prepared Direct Testimony on Behalf of the **Alberta Petroleum Marketing Commission** (R. 88-08-018 — January 25, 1991)
 - b. Prepared Responsive Testimony on Behalf of the **Alberta Petroleum Marketing Commission** (R. 88-08-018 — March 29, 1991)
 - *Brokering of interstate pipeline capacity; intrastate transportation policies.*
7. Prepared Direct Testimony on Behalf of the **Canadian Producer Group** (A. 90-08-029/Phase II — April 17, 1991)
 - *Natural gas brokerage and transport fees.*
8. Prepared Direct Testimony on Behalf of **LUZ Partnership Management** (A. 91-01-027 — July 15, 1991)
 - *Natural gas parity rates for cogenerators and solar thermal power plants.*
9. Prepared Joint Testimony of R. Thomas Beach and Dr. Robert B. Weisenmiller on Behalf of the **California Cogeneration Council** (I. 89-07-004 — July 15, 1991)
 - *Avoided cost pricing; use of published natural gas price indices to set avoided cost prices for qualifying facilities.*
10.
 - a. Prepared Direct Testimony on Behalf of the **Indicated Expansion Shippers** (A. 89-04-033 — October 28, 1991)
 - b. Prepared Rebuttal Testimony on Behalf of the **Indicated Expansion Shippers** (A. 89-04-0033 — November 26, 1991)
 - *Natural gas pipeline rate design; cost/benefit analysis of rolled-in rates.*
11. Prepared Direct Testimony on Behalf of the **Independent Petroleum Association of Canada** (A. 91-04-003 — January 17, 1992)
 - *Natural gas procurement policy; prudence of past gas purchases.*
12.
 - a. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (I.86-06-005/Phase II — June 18, 1992)
 - b. Prepared Rebuttal Testimony on Behalf of the **California Cogeneration Council** (I. 86-06-005/Phase II — July 2, 1992)
 - *Long-Run Marginal Cost (LRMC) rate design for natural gas utilities.*
13. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (A. 92-10-017 — February 19, 1993)
 - *Performance-based ratemaking for electric utilities.*

14. Prepared Direct Testimony on Behalf of the **SEGS Projects** (C. 93-02-014/A. 93-03-053 — May 21, 1993)
 - *Natural gas transportation service for wholesale customers.*
15. a. Prepared Direct Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038 — June 28, 1993)
b. Prepared Rebuttal Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038 — July 8, 1993)
 - *Natural gas pipeline rate design issues.*
16. a. Prepared Direct Testimony on Behalf of the **SEGS Projects** (C. 93-05-023 — November 10, 1993)
b. Prepared Rebuttal Testimony on Behalf of the **SEGS Projects** (C. 93-05-023 — January 10, 1994)
 - *Utility overcharges for natural gas service; cogeneration parity issues.*
17. Prepared Direct Testimony on Behalf of the **City of Vernon** (A. 93-09-006/A. 93-08-022/A. 93-09-048 — June 17, 1994)
 - *Natural gas rate design for wholesale customers; retail competition issues.*
18. Prepared Direct Testimony of R. Thomas Beach on Behalf of the **SEGS Projects** (A. 94-01-021 — August 5, 1994)
 - *Natural gas rate design issues; rate parity for solar thermal power plants.*
19. Prepared Direct Testimony on Transition Cost Issues on Behalf of **Watson Cogeneration Company** (R. 94-04-031/I. 94-04-032 — December 5, 1994)
 - *Policy issues concerning the calculation, allocation, and recovery of transition costs associated with electric industry restructuring.*
20. Prepared Direct Testimony on Nuclear Cost Recovery Issues on Behalf of the **California Cogeneration Council** (A. 93-12-025/I. 94-02-002 — February 14, 1995)
 - *Recovery of above-market nuclear plant costs under electric restructuring.*
21. Prepared Direct Testimony on Behalf of the **Sacramento Municipal Utility District** (A. 94-11-015 — June 16, 1995)
 - *Natural gas rate design; unbundled mainline transportation rates.*

22. Prepared Direct Testimony on Behalf of **Watson Cogeneration Company** (A. 95-05-049 — September 11, 1995)
 - *Incremental Energy Rates; air quality compliance costs.*
23. a. Prepared Direct Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038/A. 94-05-035/A. 94-06-034/A. 94-09-056/A. 94-06-044 — January 30, 1996)
b. Prepared Rebuttal Testimony on Behalf of the **Canadian Association of Petroleum Producers** (A. 92-12-043/A. 93-03-038/A. 94-05-035/A. 94-06-034/A. 94-09-056/A. 94-06-044 — February 28, 1996)
 - *Natural gas market dynamics; gas pipeline rate design.*
24. Prepared Direct Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (A. 96-03-031 — July 12, 1996)
 - *Natural gas rate design: parity rates for cogenerators.*
25. Prepared Direct Testimony on Behalf of the **City of Vernon** (A. 96-10-038 — August 6, 1997)
 - *Impacts of a major utility merger on competition in natural gas and electric markets.*
26. a. Prepared Direct Testimony on Behalf of the **Electricity Generation Coalition** (A. 97-03-002 — December 18, 1997)
b. Prepared Rebuttal Testimony on Behalf of the **Electricity Generation Coalition** (A. 97-03-002 — January 9, 1998)
 - *Natural gas rate design for gas-fired electric generators.*
27. Prepared Direct Testimony on Behalf of the **City of Vernon** (A. 97-03-015 — January 16, 1998)
 - *Natural gas service to Baja, California, Mexico.*

28. a. Prepared Direct Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (A. 98-10-012/A. 98-10-031/A. 98-07-005 — March 4, 1999).
- b. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (A. 98-10-012/A. 98-01-031/A. 98-07-005 — March 15, 1999).
- c. Prepared Direct Testimony on Behalf of the **California Cogeneration Council** (A. 98-10-012/A. 98-01-031/A. 98-07-005 — June 25, 1999).
- *Natural gas cost allocation and rate design for gas-fired electric generators.*
29. a. Prepared Direct Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (R. 99-11-022 — February 11, 2000).
- b. Prepared Rebuttal Testimony on Behalf of the **California Cogeneration Council and Watson Cogeneration Company** (R. 99-11-022 — March 6, 2000).
- c. Prepared Direct Testimony on Line Loss Issues of behalf of the **California Cogeneration Council** (R. 99-11-022 — April 28, 2000).
- d. Supplemental Direct Testimony in Response to ALJ Cooke's Request on behalf of the **California Cogeneration Council and Watson Cogeneration Company** (R. 99-11-022 — April 28, 2000).
- e. Prepared Rebuttal Testimony on Line Loss Issues on behalf of the **California Cogeneration Council** (R. 99-11-022 — May 8, 2000).
- *Market-based, avoided cost pricing for the electric output of gas-fired cogeneration facilities in the California market; electric line losses.*
30. a. Direct Testimony on behalf of the **Indicated Electric Generators** in Support of the Comprehensive Gas OII Settlement Agreement for Southern California Gas Company and San Diego Gas & Electric Company (I. 99-07-003 — May 5, 2000).
- b. Rebuttal Testimony in Support of the Comprehensive Settlement Agreement on behalf of the **Indicated Electric Generators** (I. 99-07-003 — May 19, 2000).
- *Testimony in support of a comprehensive restructuring of natural gas rates and services on the Southern California Gas Company system. Natural gas cost allocation and rate design for gas-fired electric generators.*
31. a. Prepared Direct Testimony on the Cogeneration Gas Allowance on behalf of the **California Cogeneration Council** (A. 00-04-002 — September 1, 2000).
- b. Prepared Direct Testimony on behalf of **Southern Energy California** (A. 00-04-002 — September 1, 2000).
- *Natural gas cost allocation and rate design for gas-fired electric generators.*

32. a. Prepared Direct Testimony on behalf of **Watson Cogeneration Company** (A. 00-06-032 — September 18, 2000).
b. Prepared Rebuttal Testimony on behalf of **Watson Cogeneration Company** (A. 00-06-032 — October 6, 2000).
- *Rate design for a natural gas “peaking service.”*
33. a. Prepared Direct Testimony on behalf of **PG&E National Energy Group & Calpine Corporation** (I. 00-11-002—April 25, 2001).
b. Prepared Rebuttal Testimony on behalf of **PG&E National Energy Group & Calpine Corporation** (I. 00-11-002—May 15, 2001).
- *Terms and conditions of natural gas service to electric generators; gas curtailment policies.*
34. a. Prepared Direct Testimony on behalf of the **California Cogeneration Council** (R. 99-11-022—May 7, 2001).
b. Prepared Rebuttal Testimony on behalf of the **California Cogeneration Council** (R. 99-11-022—May 30, 2001).
- *Avoided cost pricing for alternative energy producers in California.*
35. a. Prepared Direct Testimony of R. Thomas Beach in Support of the Application of **Wild Goose Storage Inc.** (A. 01-06-029—June 18, 2001).
b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Wild Goose Storage** (A. 01-06-029—November 2, 2001)
- *Consumer benefits from expanded natural gas storage capacity in California.*
36. Prepared Direct Testimony of R. Thomas Beach on behalf of the **County of San Bernardino** (I. 01-06-047—December 14, 2001)
- *Reasonableness review of a natural gas utility’s procurement practices and storage operations.*
37. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024—May 31, 2002)
b. Prepared Supplemental Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024—May 31, 2002)
- *Electric procurement policies for California’s electric utilities in the aftermath of the California energy crisis.*

38. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers & Technology Association** (R. 02-01-011—June 6, 2002)
 - *“Exit fees” for direct access customers in California.*
39. Prepared Direct Testimony of R. Thomas Beach on behalf of the **County of San Bernardino** (A. 02-02-012 — August 5, 2002)
 - *General rate case issues for a natural gas utility; reasonableness review of a natural gas utility’s procurement practices.*
40. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association** (A. 98-07-003 — February 7, 2003)
 - *Recovery of past utility procurement costs from direct access customers.*
41.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council, the California Manufacturers & Technology Association, Calpine Corporation, and Mirant Americas, Inc.** (A 01-10-011 — February 28, 2003)
 - b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council, the California Manufacturers & Technology Association, Calpine Corporation, and Mirant Americas, Inc.** (A 01-10-011 — March 24, 2003)
 - *Rate design issues for Pacific Gas & Electric’s gas transmission system (Gas Accord II).*
42.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers & Technology Association; Calpine Corporation; Duke Energy North America; Mirant Americas, Inc.; Watson Cogeneration Company; and West Coast Power, Inc.** (R. 02-06-041 — March 21, 2003)
 - b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Manufacturers & Technology Association; Calpine Corporation; Duke Energy North America; Mirant Americas, Inc.; Watson Cogeneration Company; and West Coast Power, Inc.** (R. 02-06-041 — April 4, 2003)
 - *Cost allocation of above-market interstate pipeline costs for the California natural gas utilities.*
43. Prepared Direct Testimony of R. Thomas Beach and Nancy Rader on behalf of the **California Wind Energy Association** (R. 01-10-024 — April 1, 2003)
 - *Design and implementation of a Renewable Portfolio Standard in California.*

44. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024 — June 23, 2003)
- b. Prepared Supplemental Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 01-10-024 — June 29, 2003)
- *Power procurement policies for electric utilities in California.*
45. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Indicated Commercial Parties** (02-05-004 — August 29, 2003)
- *Electric revenue allocation and rate design for commercial customers in southern California.*
46. a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Calpine Corporation and the California Cogeneration Council** (A. 04-03-021 — July 16, 2004)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Calpine Corporation and the California Cogeneration Council** (A. 04-03-021 — July 26, 2004)
- *Policy and rate design issues for Pacific Gas & Electric's gas transmission system (Gas Accord III).*
47. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (A. 04-04-003 — August 6, 2004)
- *Policy and contract issues concerning cogeneration QFs in California.*
48. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council and the California Manufacturers and Technology Association** (A. 04-07-044 — January 11, 2005)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council and the California Manufacturers and Technology Association** (A. 04-07-044 — January 28, 2005)
- *Natural gas cost allocation and rate design for large transportation customers in northern California.*
49. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 04-06-024 — March 7, 2005)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 04-06-024 — April 26, 2005)
- *Electric marginal costs, revenue allocation, and rate design for commercial and industrial electric customers in northern California.*

50. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Solar Energy Industries Association** (R. 04-03-017 — April 28, 2005)
 - *Cost-effectiveness of the Million Solar Roofs Program.*
51. Prepared Direct Testimony of R. Thomas Beach on behalf of **Watson Cogeneration Company, the Indicated Producers, and the California Manufacturing and Technology Association** (A. 04-12-004 — July 29, 2005)
 - *Natural gas rate design policy; integration of gas utility systems.*
52.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 04-04-003/R. 04-04-025 — August 31, 2005)
 - b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 04-04-003/R. 04-04-025 — October 28, 2005)
 - *Avoided cost rates and contracting policies for QFs in California*
53.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 05-05-023 — January 20, 2006)
 - b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 05-05-023 — February 24, 2006)
 - *Electric marginal costs, revenue allocation, and rate design for commercial and industrial electric customers in southern California.*
54.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Producers** (R. 04-08-018 – January 30, 2006)
 - b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **California Producers** (R. 04-08-018 – February 21, 2006)
 - *Transportation and balancing issues concerning California gas production.*
55. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Manufacturers and Technology Association and the Indicated Commercial Parties** (A. 06-03-005 — October 27, 2006)
 - *Electric marginal costs, revenue allocation, and rate design for commercial and industrial electric customers in northern California.*
56. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (A. 05-12-030 — March 29, 2006)
 - *Review and approval of a new contract with a gas-fired cogeneration project.*

57. a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Watson Cogeneration, Indicated Producers, the California Cogeneration Council, and the California Manufacturers and Technology Association** (A. 04-12-004 — July 14, 2006)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Watson Cogeneration, Indicated Producers, the California Cogeneration Council, and the California Manufacturers and Technology Association** (A. 04-12-004 — July 31, 2006)
- *Restructuring of the natural gas system in southern California to include firm capacity rights; unbundling of natural gas services; risk/reward issues for natural gas utilities.*
58. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 06-02-013 — March 2, 2007)
- *Utility procurement policies concerning gas-fired cogeneration facilities.*
59. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 07-01-047 — August 10, 2007)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 07-01-047 — September 24, 2007)
- *Electric rate design issues that impact customers installing solar photovoltaic systems.*
60. a. Prepared Direct Testimony of R. Thomas Beach on Behalf of **Gas Transmission Northwest Corporation** (A. 07-12-021 — May 15, 2008)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on Behalf of **Gas Transmission Northwest Corporation** (A. 07-12-021 — June 13, 2008)
- *Utility subscription to new natural gas pipeline capacity serving California.*
61. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 08-03-015 — September 12, 2008)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 08-03-015 — October 3, 2008)
- *Issues concerning the design of a utility-sponsored program to install 500 MW of utility- and independently-owned solar photovoltaic systems.*

62. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 08-03-002 — October 31, 2008)
- *Electric rate design issues that impact customers installing solar photovoltaic systems.*
63. a. Phase II Direct Testimony of R. Thomas Beach on behalf of **Indicated Producers, the California Cogeneration Council, California Manufacturers and Technology Association, and Watson Cogeneration Company** (A. 08-02-001 — December 23, 2008)
- b. Phase II Rebuttal Testimony of R. Thomas Beach on behalf of **Indicated Producers, the California Cogeneration Council, California Manufacturers and Technology Association, and Watson Cogeneration Company** (A. 08-02-001 — January 27, 2009)
- *Natural gas cost allocation and rate design issues for large customers.*
64. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (A. 09-05-026 — November 4, 2009)
- *Natural gas cost allocation and rate design issues for large customers.*
65. a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Indicated Producers and Watson Cogeneration Company** (A. 10-03-028 — October 5, 2010)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Indicated Producers and Watson Cogeneration Company** (A. 10-03-028 — October 26, 2010)
- *Revisions to a program of firm backbone capacity rights on natural gas pipelines.*
66. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 10-03-014 — October 6, 2010)
- *Electric rate design issues that impact customers installing solar photovoltaic systems.*
67. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Indicated Settling Parties** (A. 09-09-013 — October 11, 2010)
- *Testimony on proposed modifications to a broad-based settlement of rate-related issues on the Pacific Gas & Electric natural gas pipeline system.*

68. a. Supplemental Prepared Direct Testimony of R. Thomas Beach on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 6, 2010)
- b. Supplemental Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 13, 2010)
- c. Supplemental Prepared Reply Testimony of R. Thomas Beach on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 20, 2010)
- *Local reliability benefits of a new natural gas storage facility.*
69. Prepared Direct Testimony of R. Thomas Beach on behalf of **The Vote Solar Initiative** (A. 10-11-015—June 1, 2011)
- *Distributed generation policies; utility distribution planning.*
70. Prepared Reply Testimony of R. Thomas Beach on behalf of the **Solar Alliance** (A. 10-03-014—August 5, 2011)
- *Electric rate design for commercial & industrial solar customers.*
71. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 11-06-007—February 6, 2012)
- *Electric rate design for solar customers; marginal costs.*
72. a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Northern California Indicated Producers** (R.11-02-019—January 31, 2012)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Northern California Indicated Producers** (R. 11-02-019—February 28, 2012)
- *Natural gas pipeline safety policies and costs*
73. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 11-10-002—June 12, 2012)
- *Electric rate design for solar customers; marginal costs.*
74. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Southern California Indicated Producers and Watson Cogeneration Company** (A. 11-11-002—June 19, 2012)
- *Natural gas pipeline safety policies and costs*

75. a. Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 12-03-014—June 25, 2012)
- b. Reply Testimony of R. Thomas Beach on behalf of the **California Cogeneration Council** (R. 12-03-014—July 23, 2012)
- *Ability of combined heat and power resources to serve local reliability needs in southern California.*
76. a. Prepared Testimony of R. Thomas Beach on behalf of the **Southern California Indicated Producers and Watson Cogeneration Company** (A. 11-11-002, Phase 2—November 16, 2012)
- b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Southern California Indicated Producers and Watson Cogeneration Company** (A. 11-11-002, Phase 2—December 14, 2012)
- *Allocation and recovery of natural gas pipeline safety costs.*
77. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 12-12-002—May 10, 2013)
- *Electric rate design for commercial & industrial solar customers; marginal costs.*
78. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 13-04-012—December 13, 2013)
- *Electric rate design for commercial & industrial solar customers; marginal costs.*
79. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 13-12-015—June 30, 2014)
- *Electric rate design for commercial & industrial solar customers; residential time-of-use rate design issues.*

80.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of **Calpine Corporation and the Indicated Shippers** (A. 13-12-012—August 11, 2014)
 - b. Prepared Direct Testimony of R. Thomas Beach on behalf of **Calpine Corporation, the Canadian Association of Petroleum Producers, Gas Transmission Northwest, and the City of Palo Alto** (A. 13-12-012—August 11, 2014)
 - c. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Calpine Corporation** (A. 13-12-012—September 15, 2014)
 - d. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of **Calpine Corporation, the Canadian Association of Petroleum Producers, Gas Transmission Northwest, and the City of Palo Alto** (A. 13-12-012—September 15, 2014)
 - *Rate design, cost allocation, and revenue requirement issues for the gas transmission system of a major natural gas utility.*
81. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (R. 12-06-013—September 15, 2014)
 - *Comprehensive review of policies for rate design for residential electric customers in California.*
82. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 14-06-014—March 13, 2015)
 - *Electric rate design for commercial & industrial solar customers; marginal costs.*
83.
 - a. Prepared Direct Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A.14-11-014—May 1, 2015)
 - b. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Solar Energy Industries Association** (A. 14-11-014—May 26, 2015)
 - *Time-of-use periods for residential TOU rates.*
84. Prepared Rebuttal Testimony of R. Thomas Beach on behalf of the **Joint Solar Parties** (R. 14-07-002—September 30, 2015)
 - *Electric rate design issues concerning proposals for the net energy metering successor tariff in California.*

EXPERT WITNESS TESTIMONY BEFORE THE COLORADO PUBLIC UTILITIES COMMISSION

1. Direct Testimony and Exhibits of R. Thomas Beach on behalf of the Colorado Solar Energy Industries Association and the Solar Alliance, (Docket No. 09AL-299E – October 2, 2009).

https://www.dora.state.co.us/pls/efi/DDMS_Public.Display_Document?p_section=PUC&p_source=EFI_PRIVATE&p_doc_id=3470190&p_doc_key=0CD8F7FCDB673F1043928849D9D8CAB1&p_handle_not_found=Y

- *Electric rate design policies to encourage the use of distributed solar generation.*
2. Direct Testimony and Exhibits of R. Thomas Beach on behalf of the Vote Solar Initiative and the Interstate Renewable Energy Council, (Docket No. 11A-418E – September 21, 2011).
- *Development of a community solar program for Xcel Energy.*

EXPERT WITNESS TESTIMONY BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

1. Direct Testimony of R. Thomas Beach on behalf of the **Idaho Conservation League** (Case No. IPC-E-12-27—May 10, 2013)

- *Costs and benefits of net energy metering in Idaho.*
2. a. Direct Testimony of R. Thomas Beach on behalf of the **Idaho Conservation League and the Sierra Club** (Case Nos. IPC-E-15-01/AVU-4-15-01/PAC-E-15-03 — April 23, 2015)
 - b. Rebuttal Testimony of R. Thomas Beach on behalf of the **Idaho Conservation League and the Sierra Club** (Case Nos. IPC-E-15-01/AVU-4-15-01/PAC-E-15-03 — May 14, 2015)
- *Issues concerning the term of PURPA contracts in Idaho.*

EXPERT WITNESS TESTIMONY BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

1. Direct and Rebuttal Testimony of R. Thomas Beach on Behalf of Geronimo Energy, LLC. (In the Matter of the Petition of Northern States Power Company to Initiate a Competitive Resource Acquisition Process [OAH Docket No. 8-2500-30760, MPUC Docket No. E002/CN-12-1240, September 27 and October 18, 2013])

- *Testimony in support of a competitive bid from a distributed solar project in an all-source solicitation for generating capacity.*

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC UTILITIES COMMISSION OF NEVADA

1. Pre-filed Direct Testimony on Behalf of the **Nevada Geothermal Industry Council** (Docket No. 97-2001—May 28, 1997)
 - *Avoided cost pricing for the electric output of geothermal generation facilities in Nevada.*
2. Pre-filed Direct Testimony on Behalf of **Nevada Sun-Peak Limited Partnership** (Docket No. 97-6008—September 5, 1997)
 - *QF pricing issues in Nevada.*
3. Pre-filed Direct Testimony on Behalf of the **Nevada Geothermal Industry Council** (Docket No. 98-2002 — June 18, 1998)
 - *Market-based, avoided cost pricing for the electric output of geothermal generation facilities in Nevada.*

EXPERT WITNESS TESTIMONY BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

Direct Testimony of R. Thomas Beach on Behalf of the **Interstate Renewable Energy Council** (Case No. 10-00086-UT—February 28, 2011)

<http://164.64.85.108/infodocs/2011/3/PRS20156810DOC.PDF>

- *Testimony on proposed standby rates for new distributed generation projects; cost-effectiveness of DG in New Mexico.*
1. Direct Testimony and Exhibits of R. Thomas Beach on behalf of the **New Mexico Independent Power Producers** (Case No. 11-00265-UT, October 3, 2011)
 - *Cost cap for the Renewable Portfolio Standard program in New Mexico*

EXPERT WITNESS TESTIMONY BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

1. Direct, Response, and Rebuttal Testimony of R. Thomas Beach on Behalf of the North Carolina Sustainable Energy Association. (In the Matter of Biennial Determination of Avoided Cost Rates for Electric Utility Purchases from Qualifying Facilities – 2014; Docket E-100 Sub 140; April 25, May 30, and June 20, 2014)
 - *Testimony on avoided cost issues related to solar and renewable qualifying facilities in North Carolina.*

April 25, 2014:

<http://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=89f3b50f-17cb-4218-87bd-c743e1238bc1>
May 30, 2014:

<http://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=19e0b58d-a7f6-4d0d-9f4a-08260e561443>

June 20, 2104:

<http://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=bd549755-d1b8-4c9b-b4a1-fc6e0bd2f9a2>

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC UTILITIES COMMISSION OF OREGON

1. a. Direct Testimony of Behalf of **Weyerhaeuser Company** (UM 1129 — August 3, 2004)
- b. Surrebuttal Testimony of Behalf of **Weyerhaeuser Company** (UM 1129 — October 14, 2004)
2. a. Direct Testimony of Behalf of **Weyerhaeuser Company and the Industrial Customers of Northwest Utilities** (UM 1129 / Phase II — February 27, 2006)
- b. Rebuttal Testimony of Behalf of **Weyerhaeuser Company and the Industrial Customers of Northwest Utilities** (UM 1129 / Phase II — April 7, 2006)
- *Policies to promote the development of cogeneration and other qualifying facilities in Oregon.*

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA

1. Direct Testimony and Exhibits of R. Thomas Beach on behalf of **The Alliance for Solar Choice** (Docket No. 2014-246-E – December 11, 2014)
<https://dms.psc.sc.gov/attachments/matter/B7BACF7A-155D-141F-236BC437749BEF85>

- *Methodology for evaluating the cost-effectiveness of net energy metering*

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

1. Direct Testimony of R. Thomas Beach on behalf of the **Sierra Club** (Docket No. 15-035-53—September 15, 2015)
- *Issues concerning the term of PURPA contracts in Idaho.*

EXPERT WITNESS TESTIMONY BEFORE THE VERMONT PUBLIC SERVICE BOARD

1. Pre-filed Testimony of R. Thomas Beach and Patrick McGuire on Behalf of **Allco Renewable Energy Limited** (Docket No. 8010 — September 26, 2014)

- *Avoided cost pricing issues in Vermont*

EXPERT WITNESS TESTIMONY BEFORE THE VIRGINIA CORPORATION COMMISSION

Direct Testimony and Exhibits of R. Thomas Beach on Behalf of the Maryland – District of Columbia – Virginia Solar Energy Industries Association, (Case No. PUE-2011-00088, October 11, 2011) <http://www.scc.virginia.gov/docketsearch/DOCS/2gx%2501!.PDF>

- *Cost-effectiveness of, and standby rates for, net-metered solar customers.*

LITIGATION EXPERIENCE

Mr. Beach has been retained as an expert in a variety of civil litigation matters. His work has included the preparation of reports on the following topics:

- The calculation of damages in disputes over the pricing terms of natural gas sales contracts (2 separate cases).
- The valuation of a contract for the purchase of power produced from wind generators.
- The compliance of cogeneration facilities with the policies and regulations applicable to Qualifying Facilities (QFs) under PURPA in California.
- Audit reports on the obligations of buyers and sellers under direct access electric contracts in the California market (2 separate cases).
- The valuation of interstate pipeline capacity contracts (3 separate cases).

In several of these matters, Mr. Beach was deposed by opposing counsel. Mr. Beach has also testified at trial in the bankruptcy of a major U.S. energy company, and has been retained as a consultant in anti-trust litigation concerning the California natural gas market in the period prior to and during the 2000-2001 California energy crisis.