INFORMATION SHEET

PRESIDING: Chair Mitchell, Commissioners Brown-Bland, Gray, Clodfelter
PLACE: Dobbs Building, Raleigh, North Carolina
DATE: July 19, 2019
TIME: 9:31 a.m. to 12:58 p.m.
DOCKET NO.: E-100, Sub 158
COMPANIES: Duke Energy Progress, LLC, Duke Energy Carolinas, LLC, and Dominion Energy North Carolina
DESCRIPTION: In the Matter of Generic Electric, Biennial Determination of Avoided Cost Rates for Electric Utility Purchases from Qualifying Facilities - 2018
VOLUME: 7

APPEARANCES
(See attached.)

EXHIBITS

(See attached.)

COPIES ORDERED: Email: Fentress, Grigg, Dantonio, Smith, Bowen, Hutt, Kemerait, Levitas, Ross, Snowden, Wills, Quinn, Harrod, Dodge, Cummings

REPORTED BY: Linda Garrett
TRANSCRIBED BY: Linda Garrett
DATE TRANSCRIBED: July 30, 2019

TRANSCRIPT PAGES: 157
PREFILED PAGES: -0-

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3 AND DUKE ENERGY PROGRESS, LLC:

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5 Duke Energy Corporation

6 Associate General Counsel

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8 Raleigh, North Carolina 27602

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12 434 Fayetteville Street, Suite 2600

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17 Nick Dantonio, Esq.

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3 ASSOCIATION:

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7 Raleigh, North Carolina 27609

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9 FOR SOUTHERN ALLIANCE FOR CLEAN ENERGY:

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11 Senior Attorney

12 Maia Hutt, Esq.

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14 Southern Environmental Law Center

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16 Chapel Hill, North Carolina 27516

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18 FOR NORTH CAROLINA CLEAN ENERGY BUSINESS ALLIANCE

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23 Raleigh, North Carolina 27601

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1 A P P E A R A N C E S (Cont'd.)

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4 Kilpatrick Townsend

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6 Raleigh, North Carolina 27609

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10 Fox Rothschild, LLP

11 434 Fayetteville Street, Suite 2800

12 Raleigh, North Carolina 27601

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14 FOR CUBE YADKIN GENERATION:

15 Ben Snowden, Esq.

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17 4208 Six Forks Road, Suite 1400

18 Raleigh, North Carolina 27609

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1 A P P E A R A N C E S (Cont'd.):

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5 Durham, North Carolina 27705

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7 Matthew D. Quinn, Esq.

8 Lewis & Roberts, PLLC

9 3700 Glenwood Avenue, Suite 410

10 Raleigh, North Carolina 27612

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12 FOR CAROLINA UTILITY CUSTOMERS ASSOCIATION, INC.:

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14 Crisp & Page

15 4010 Barrett Drive, Suite 205

16 Raleigh, North Carolina 27609

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24

1 A P P E A R A N C E S (Cont'd.):

2 FOR THE USING AND CONSUMING PUBLIC AND ON BEHALF OF

3 THE STATE AND ITS CITIZENS IN THIS MATTER AFFECTING

4 THE PUBLIC INTEREST:

5 Jennifer Harrod, Esq.

6 Special Deputy Attorney General

7 Teresa Townsend, Esq.

8 Special Deputy Attorney General

9 Office of the North Carolina Attorney General

10 114 West Edenton Street

11 Raleigh, North Carolina 27603

12

13 FOR THE USING AND CONSUMING PUBLIC:

14 Tim Dodge, Esq.

15 Layla Cummings, Esq.

16 Lucy Edmondson, Esq.

17 Heather Fennell, Esq.

18 Public Staff - North Carolina Utilities

19 Commission

20 4326 Mail Service Center

21 Raleigh, North Carolina 27699-4300

22

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Kendrick Fentress

FIRM NAME: Duke Energy

ADDRESS: 410 S. Wilmington St.

CITY: Raleigh STATE: NC ZIP CODE: 27601

APPEARING FOR: Duke Energy

APPLICANT: ✓ COMPLAINANT:____ INTERVENOR:____

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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Email: Kendrick.Fentress@duke-energy.com

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Signature: Kendrick C. Fentress

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 2-15 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Brett Breitschwerdt

FIRM NAME: McGuire Woods

ADDRESS:

CITY: STATE: ZIP CODE:

APPEARING FOR: Duke Energy Carolinas, LLC and Duke Energy Progress, LLC

APPLICANT: ✓ COMPLAINANT: INTERVENOR:

PROTESTANT: RESPONDENT: DEFENDANT:

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 Sub 159

ATTORNEY NAME and TITLE: Mary Lynne Grigg

FIRM NAME: McGuireWoods LLP

ADDRESS: 434 Fayetteville St Suite 2600

CITY: Raleigh STATE: _____ ZIP CODE: 27601

APPEARING FOR: Dominion Energy

APPLICANT: ✓ COMPLAINANT: ____ INTERVENOR: ____

PROTESTANT: ____ RESPONDENT: ____ DEFENDANT: ____

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Nick Dantonio

FIRM NAME: McGuireWoods

ADDRESS: 434 Fayetteville Street Suite 2600

CITY: Raleigh STATE: NC ZIP CODE: 27601

APPEARING FOR: Dominion Energy North Carolina

APPLICANT: X COMPLAINANT:____ INTERVENOR:____

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15/2019 DOCKET NO.: E-100, Sub 158

ATTORNEY NAME and TITLE: Benjamin Smith, Regulatory Counsel

FIRM NAME: —

ADDRESS: 4800 Six Forks Road, Ste. 300

CITY: Raleigh STATE: NC ZIP CODE: 27609

APPEARING FOR: NCSEA

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 Sub 156

ATTORNEY NAME and TITLE: Lauren Bowen, Senior Attorney

FIRM NAME: Southern Environmental Law Center

ADDRESS: 601 W Rosemary St Ste 220

CITY: Chapel STATE: NC ZIP CODE: 27516

APPEARING FOR: Southern Alliance for Clean Energy

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Maia Hutt, Associate Attorney

FIRM NAME: Southern Environmental Law Center

ADDRESS: 601 W Rosemary St. Suite 220

CITY: Chapel Hill STATE: NC ZIP CODE: 27516

APPEARING FOR: Southern Alliance for Clean Energy

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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Signature: Maia Hutt

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE: 7/12/2019 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Karen Kemerait, attorney for

FIRM NAME: Fox Rothschild NCCEBA &

ADDRESS: Ecoplexus

CITY: STATE: ZIP CODE:

APPEARING FOR: NCCEBA & Ecoplexus Inc

APPLICANT: COMPLAINANT: INTERVENOR: ✓

PROTESTANT: RESPONDENT: DEFENDANT:

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APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 sub 158

ATTORNEY NAME and TITLE: Steven Levitas

FIRM NAME: Kilpatrick Townsend

ADDRESS: 4208 Six Forks Road

CITY: Raleigh STATE: NC ZIP CODE: 27609

APPEARING FOR: NCCEBA

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100, Sub 158

ATTORNEY NAME and TITLE: Deborah Ross, Counsel

FIRM NAME: Fox Rothschild LLP

ADDRESS: 434 Fayetteville Street, Suite 2800

CITY: Raleigh STATE: NC ZIP CODE: 27601

APPEARING FOR: NC Small Hydro Group

APPLICANT:____ COMPLAINANT:____ INTERVENOR: X

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE: 7/15/2019 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Ben Snowden, Counsel

FIRM NAME: Kilpatrick Townsend Stockton

ADDRESS: 4208 Six Forks Rd. Suite 1400

CITY: Raleigh STATE: NC ZIP CODE: 27609

APPEARING FOR: Cube Yadkin Generation

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Kristen Wills

FIRM NAME: NC WARN

ADDRESS: 2812 Hillsborough Rd

CITY: Durham STATE: NC ZIP CODE: 27705

APPEARING FOR: NC WARN

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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Email: kristen@ncwarn.org

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100, Sub 158

ATTORNEY NAME and TITLE: Matthew D. Quinn, Attorney

FIRM NAME: Lewis & Roberts, PLLC

ADDRESS: 3700 Glenwood Ave., Ste 410

CITY: Raleigh STATE: NC ZIP CODE: 27612

APPEARING FOR: NC WARN

APPLICANT:____ COMPLAINANT:____ INTERVENOR: ✓

PROTESTANT:____ RESPONDENT:____ DEFENDANT:____

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: July 15, 2019 DOCKET NO.: E-100, Sub 158

ATTORNEY NAME and TITLE: Robert F. Page

FIRM NAME: Craig & Page

ADDRESS: 4010 Barrett Drive, Suite 205

CITY: Raleigh STATE: NC ZIP CODE: 27609

APPEARING FOR: Carolina Utility Customers Association

APPLICANT:_____ COMPLAINANT:_____ INTERVENOR: ✓

PROTESTANT:_____ RESPONDENT:_____ DEFENDANT:_____

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NORTH CAROLINA UTILITIES COMMISSION

APPEARANCE SLIP

DATE: 7/15/19 DOCKET NO.: E-100 Sub 158

ATTORNEY NAME and TITLE: Jennifer Harrod, Special Dep. Atty General
Teresa Townsend

FIRM NAME: Office of the NC Attorney General

ADDRESS: 114 W. Edenton St

CITY: Raleigh STATE: NC ZIP CODE: 27603

APPEARING FOR: On behalf of the using and consuming public and on behalf of the State and its citizens in this matter affecting the public interest

APPLICANT:_____ COMPLAINANT:_____ INTERVENOR: X

PROTESTANT:_____ RESPONDENT:_____ DEFENDANT:_____

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Email: jharrod@ncdoj.gov

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NORTH CAROLINA UTILITIES COMMISSION
PUBLIC STAFF - APPEARANCE SLIP

DATE July 15, 2019 DOCKET #: E-100, Sub 158

PUBLIC STAFF MEMBER Tim Dodge and Layla Cummings

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Tim Dodge and Layla Cummings

Signature of Public Staff Member

/A
Vol. 7

Glick Exhibit A

Synapse
Energy Economics, Inc.

Devi Glick, Senior Associate

Synapse Energy Economics I 485 Massachusetts Avenue, Suite 2 I Cambridge, MA 02139
dglick@synapse-energy.com

PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Senior Associate*, April 2019 – Present, *Associate*, January 2018 – March 2019

Conducts research and provides consulting on energy sector issues. Examples include:

- Modeling for resource planning using PLEXOS and Encompass utility planning software to evaluate the reasonableness of utility IRP modeling.
- Modeling for resource planning to explore alternative, lower cost and lower emission resource portfolio options.
- Assessing the reasonableness of methodologies and assumptions relied on in utility IRPs and other long-term planning documents in Kentucky, South Africa, New Mexico, Florida, South Carolina, and North Carolina.
- Contributing to the evaluation of the economics of utility plant operation and capacity planning decisions relative to market prices and alternative resource costs.
- Serving as an expert witness on avoided cost of distributed solar PV and submitting direct and surrebuttal testimony regarding the appropriate calculation of benefit categories associated with the value of solar calculations.
- Reviewing, assessing, and co-authoring public comments on the adequacy of utility coal ash disposal plans, and federal coal ash disposal rules and amendments.
- Analyzing system-level cost impacts of energy efficiency at the state and national level.
- Developing a manual and providing quality control for a tool to analyze the impacts of climate measures and energy policies in Morocco.

Rocky Mountain Institute, Basalt, CO. August 2012 – September 2017
Senior Associate

- Led technical analysis, modeling, training and capacity building work for utilities and governments in Sub-Saharan Africa around integrated resource planning for the central electricity grid energy and identified over a billion dollars in savings based on improved resource-planning processes.
- Represented RMI as a content expert and presented materials on electricity pricing and rate design at conferences and events.
- Led a project to research and evaluate utility resource planning and spending processes, focusing specifically on integrated resource planning, to highlight systematic overspending on conventional resources and underinvestment and underutilization of distributed energy resources as a least-cost alternative.

Associate

- Led modeling analysis in collaboration with NextGen Climate America which identified a CO_2 loophole in the Clean Power Plan of 250 million tons, or 41 percent of EPA projected abatement, and was submitted as an official federal comment, and led to a modification to address the loophole in the final rule.
- Led financial and economic modeling in collaboration with a major U.S. utility to quantify the impact that solar PV would have on their sales, and helped them identify alternative business models that would allow them to recapture a significant portion of this at-risk value.
- Supported the planning, content development, facilitation, and execution of numerous events and workshops with participants from across the electricity sector for RMI's Electricity Innovation Lab (eLab) initiative.
- Co-authored two studies reviewing valuation methodologies for solar PV and laying out new principles and recommendations around pricing and rate design for a distributed energy future in the United States. These studies have been highly cited by the industry and submitted as evidence in numerous Public Utility Commission rate cases.

The University of Michigan, Ann Arbor, MI. *Graduate Student Instructor*, September 2011 – July 2012

Prepared lesson plans, taught classes, graded papers and other coursework, met regularly with students.

The Virginia Sea Grant at the Virginia Institute of Marine Science, Gloucester Point, VA. *Policy Intern*, Summer 2011

Managed a communication network analysis study of coastal resource management stakeholders on the Eastern Shore of the Delmarva Peninsula.

The Commission for Environmental Cooperation (NAFTA), Montreal, QC. *Short Term Educational Program/Intern*, Summer 2010

Researched energy and climate issues relevant to the NAFTA parties to assist the executive director in conducting a GAP analysis of emission monitoring, reporting, and verification systems in North America.

Congressman Tom Allen, Portland, ME. *Technology Systems and Outreach Coordinator*, August 2007 – December 2008

Directed Congressman Allen's technology operation, responded to constituent requests, and represented the Congressman at events throughout southern Maine.

EDUCATION

The University of Michigan, Ann Arbor, MI
Master of Public Policy, Gerald R. Ford School of Public Policy, 2012
Master of Science, School of Natural Resources and the Environment, 2012

Masters Project: *Climate Change Adaptation Planning in U.S. Cities*

Middlebury College, Middlebury, VT
Bachelor of Arts, 2007
Environmental Studies, Policy Focus; Minor in Spanish
Thesis: *Environmental Security in a Changing National Security Environment: Reconciling Divergent Policy Interests, Cold War to Present*

PUBLICATIONS

Glick, D., B. Fagan, J. Frost, D. White. 2019. *Big Bend Analysis: Cleaner, Lower-Cost Alternatives to TECO's Billion-Dollar Gas Project.* Synapse Energy Economics for Sierra Club.

Glick, D., F. Ackerman, J. Frost. 2019. *Assessment of Duke Energy's Coal Ash Basin Closure Options Analysis in North Carolina.* Synapse Energy Economics for the Southern Environmental Law Center.

Glick, D., N. Peluso, R. Fagan. 2019. *San Juan Replacement Study: An alternative clean energy resource portfolio to meet Public Service Company of New Mexico's energy, capacity, and flexibility needs after the retirement of the San Juan Generating Station*. Synapse Energy Economics for Sierra Club.

Suphachalasai, S., M. Touati, F. Ackerman, P. Knight, D. Glick, A. Horowitz, J.A. Rogers, T. Amegroud. 2018. *Morocco – Energy Policy MRV: Emission Reductions from Energy Subsidies Reform and Renewable Energy Policy.* Prepared for the World Bank Group.

Camp, E., B. Fagan, J. Frost, D. Glick, A. Hopkins, A. Napoleon, N. Peluso, K. Takahashi, D. White, R. Wilson, T. Woolf. 2018. *Phase 1 Findings on Muskrat Falls Project Rate Mitigation.* Synapse Energy Economics for Board of Commissioners of Public Utilities, Province of Newfoundland and Labrador.

Allison, A., R. Wilson, D. Glick, J. Frost. 2018. *Comments on South Africa 2018 Integrated Resource Plan.* Synapse Energy Economics for Centre for Environmental Rights.

Hopkins, A. S., K. Takahashi, D. Glick, M. Whited. 2018. *Decarbonization of Heating Energy Use in California Buildings: Technology, Markets, Impacts, and Policy Solutions*. Synapse Energy Economics for the Natural Resources Defense Council.

Knight, P., E. Camp, D. Glick, M. Chang. 2018. *Analysis of the Avoided Costs of Compliance of the Massachusetts Global Warming Solutions Act*. Supplement to 2018 AESC Study. Synapse Energy Economics for Massachusetts Department of Energy Resources and Massachusetts Department of Environmental Protection.

Fagan, B., R. Wilson, S. Fields, D. Glick, D. White. 2018. *Nova Scotia Power Inc. Thermal Generation Utilization and Optimization: Economic Analysis of Retention of Fossil-Fueled Thermal Fleet To and Beyond 2030 – M08059*. Prepared for Board Counsel to the Nova Scotia Utility Review Board.

Ackerman, F., D. Glick, T. Vitolo. 2018. *Report on CCR proposed rule*. Prepared for Earthjustice.

Lashof, D. A., D. Weiskopf, D. Glick. 2014. *Potential Emission Leakage Under the Clean Power Plan and a Proposed Solution: A Comment to the US EPA*. NextGen Climate America.

Smith, O., M. Lehrman, D. Glick. 2014. *Rate Design for the Distribution Edge*. Rocky Mountain Institute.

Hansen, L., V. Lacy, D. Glick. 2013. *A Review of Solar PV Benefit & Cost Studies*. Rocky Mountain Institute.

TESTIMONY

Public Service Commission of South Carolina (Docket No. 2018-3-E): Surrebuttal testimony of Devi Glick regarding annual review of base rates of fuel costs for Duke Energy Carolinas. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. August 31, 2018.

Public Service Commission of South Carolina (Docket No. 2018-3-E): Direct testimony of Devi Glick regarding the annual review of base rates of fuel costs for Duke Energy Carolinas. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. August 17, 2018.

Public Service Commission of South Carolina (Docket No. 2018-1-E): Surrebuttal testimony of Devi Glick regarding Duke Energy Progress' net energy metering methodology for valuing distributed energy resources system within South Carolina. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. June 4, 2018.

Public Service Commission of South Carolina (Docket No. 2018-1-E): Direct testimony of Devi Glick regarding Duke Energy Progress' net energy metering methodology for valuing distributed energy resources system within South Carolina. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. May 22, 2018.

Public Service Commission of South Carolina (Docket No. 2018-2-E): Direct testimony of Devi Glick on avoided cost calculations and the costs and benefits of solar net energy metering for South Carolina Electric and Gas Company. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. April 12, 2018.

Public Service Commission of South Carolina (Docket No. 2018-2-E): Surrebuttal testimony of Devi Glick on avoided cost calculations and the costs and benefits of solar net energy metering for South Carolina Electric and Gas Company. On behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. April 4, 2018.

Resume updated April 2019

CERTIFICATE OF SERVICE

I certify that a copy of the foregoing *Responsive Testimony and Exhibits of Devi Glick*, as filed today in Docket No. E-100, Sub 158, was served on all parties of record by electronic mail or by deposit in the U.S. Mail, first-class, postage prepaid.

This 3rd day of July, 2019.

/s/ Maia Hutt
N.C. Bar No. 53764
Southern Environmental Law Center
601 West Rosemary Street, Suite 220
Chapel Hill, NC 27516
Telephone: (919) 967-1450
mhutt@selcnc.org
Attorney for SACE

Duke Energy Late-Filed Exhibit Number 1

I/A

Docket E-100 Sub 158 Duke Energy Carolinas Late Filed Exhibit No. 1

Rate Design Stipulation Method in E-100 Sub 158

Purpose: To show the resulting 1)energy and 2)capacity rates calculated under the Rate Design Stipulation method in E-100 Sub 158 based on initial input data.

1.

ENERGY

DEC-Stipulated Energy Rate Design E-100 Sub 158 using initial data

Independent Energy Price Blocks		1.Summer Premium Peak (PM)	2.Summer On-Peak (PM)	3.Summer Off-Peak	4. Winter Premium Peak (AM)	5.Winter On-Peak (AM)	6.Winter On Peak (PM)	7.Winter Off-Peak	8.Shoulder On Peak	9.Shoulder Off-Peak
		(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)
Distribution	Variable	3.56	3.81	2.95	4.91	4.14	4.08	2.69	3.55	2.77
Distribution	10 Year	4.22	4.16	2.69	5.64	4.03	4.26	2.74	3.38	2.50
Transmission	Variable	3.42	3.67	2.89	4.75	4.03	4.00	2.64	3.48	2.72
Transmission	10 Year	4.05	4.00	2.63	5.46	3.93	4.18	2.68	3.32	2.46

DEC Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Summer (Jun-Sep)	Off												On (pm)				Premium				On (pm)		Off	
Winter (Dec-Feb)	Off					On (am)	Premium			On (am)	Off							On (pm)					Off	
Shoulder (Remaining)	Off						On				Off						On							Off

2.

CAPACITY

DEC-Stipulated Capacity Rate Design E-100 Sub 158 using initial data

Independent Price Blocks		1.Summer On	2.Winter On (am)	3.Winter On (pm)
		(cents/KWH)	(cents/KWH)	(cents/KWH)
Distribution	Variable	0.00	0.00	0.00
Distribution	10 Year	0.21	0.97	0.31
Transmission	Variable	0.00	0.00	0.00
Transmission	10 Year	0.20	0.94	0.30

DEC / DEP Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Summer (Jul - Aug)																	On							
Winter (Dec - Mar)							On (am)												On (pm)					

Docket E-100 Sub 158 Duke Energy Progress Late Filed Exhibit No. 1

Rate Design Stipulation Method in E-100 Sub 158

Purpose: To show the resulting 1)energy and 2)capacity rates calculated under the Rate Design Stipulation method in E-100 Sub 158 based on initial input data.

1.

ENERGY

DEP-Stipulated Energy Rate Design E-100 Sub 158 using initial data

Independent Energy Price Blocks		1.Summer Premium Peak (PM)	2.Summer On-Peak (PM)	3.Summer Off-Peak	4. Winter Premium Peak (AM)	5.Winter On-Peak (AM)	6.Winter On-Peak (PM)	7.Winter Off-Peak	8.Shoulder On-Peak	9.Shoulder Off-Peak
		(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)	(cents/KWH)
Distribution	Variable	4.42	3.46	3.06	4.43	3.64	3.61	2.89	3.33	2.72
Distribution	10 Year	3.87	3.38	2.89	4.80	3.42	3.80	2.83	3.09	2.29
Transmission	Variable	4.28	3.28	3.00	4.30	3.56	3.52	2.83	3.28	2.68
Transmission	10 Year	3.74	3.21	2.83	4.66	3.35	3.71	2.77	3.04	2.26

DEP Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Summer (Jun-Sep)	Off													On (pm)			Premium				On (pm)	Off		
Winter (Dec-Feb)	Off				On (am)		Premium			On (am)	Off								On (pm)			Off		
Shoulder (Remaining)	Off					On					Off							On						Off

2.

CAPACITY

DEP-Stipulated Capacity Rate Design E-100 Sub 158 using initial data

Independent Price Blocks		1.Summer On		2.Winter On (am)		3.Winter On (pm)	
		(cents/KWH)		(cents/KWH)		(cents/KWH)	
Distribution	Variable	0.00		5.82		2.49	
Distribution	10 Year	0.00		10.92		4.68	
Transmission	Variable	0.00		5.71		2.45	
Transmission	10 Year	0.00		10.72		4.59	

DEC / DEP Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Summer (Jul - Aug)																	On							
Winter (Dec - Mar)							On (am)												On (pm)					

*pg. 1 of 243pgs
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in the docket
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/A
vol. 7

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 158

In the Matter of:	)	**RESPONSIVE TESTIMONY OF**
Biennial Determination of Avoided	)	**TYLER NORRIS**
Cost Rates for Electric Utility	)	**ON BEHALF OF**
Purchases from Qualifying Facilities –	)	**NORTH CAROLINA**
2018	)	**SUSTAINABLE ENERGY**
		ASSOCIATION

Exhibit 1

/A
vol. 7

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 158

In the Matter of:	)	
Biennial Determination of Avoided Cost	)	**DIRECT TESTIMONY OF**
Rates for Electric Utility Purchases from	)	**R. THOMAS BEACH**
Qualifying Facilities – 2018	)	
	)	

Exhibit 1

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 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 therestructuring 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 of 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 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 on behalf of the **California Cogeneration Council** (R. 01-10-024—May 31, 2002)
    b. Prepared Supplemental Testimony 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 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 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 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 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 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 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 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 on behalf of the **California Cogeneration Council** (R. 01-10-024 — June 23, 2003)
    b. Prepared Supplemental Testimony 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 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 on behalf of **Calpine Corporation and the California Cogeneration Council** (A. 04-03-021 — July 16, 2004)
    b. Prepared Rebuttal Testimony 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 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 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 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 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 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 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 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 on behalf of the **California Cogeneration Council** (R. 04-04-003/R. 04-04-025 — August 31, 2005)
    b. Prepared Rebuttal Testimony 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 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 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 on behalf of the **California Producers** (R. 04-08-018 – January 30, 2006)
    b. Prepared Rebuttal Testimony 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 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 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 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 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 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 on behalf of the **Solar Alliance** (A. 07-01-047 — August 10, 2007)
    b. Prepared Rebuttal Testimony 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 on Behalf of **Gas Transmission Northwest Corporation** (A. 07-12-021 — May 15, 2008)
    b. Prepared Rebuttal Testimony 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 on behalf of the **Solar Alliance** (A. 08-03-015 — September 12, 2008)
    b. Prepared Rebuttal Testimony 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 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 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 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 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 on behalf of **Indicated Producers and Watson Cogeneration Company** (A. 10-03-028 — October 5, 2010)
    b. Prepared Rebuttal Testimony 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 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 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 on behalf of **Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 6, 2010)
    b. Supplemental Prepared Rebuttal Testimony on behalf of**Sacramento Natural Gas Storage, LLC** (A. 07-04-013 — December 13, 2010)
    c. Supplemental Prepared Reply Testimony 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 on behalf of The Vote Solar Initiative (A. 10-11-015—June 1, 2011)

    - *Distributed generation policies; utility distribution planning.*

70. Prepared Reply Testimony 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 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 on behalf of the Northern California Indicated Producers (R.11-02-019—January 31, 2012)
    b. Prepared Rebuttal Testimony 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 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 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 on behalf of the California Cogeneration Council (R. 12-03-014—June 25, 2012)
    b. Repl y Testimony 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 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 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 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 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 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 on behalf of **Calpine Corporation** and the **Indicated Shippers** (A. 13-12-012—August 11, 2014)
    b. Prepared Direct Testimony 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 on behalf of **Calpine Corporation** (A. 13-12-012—September 15, 2014)
    d. Prepared Rebuttal Testimony 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 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 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 on behalf of the Solar Energy Industries Association (A.14-11-014—May 1, 2015)
    b. Prepared Rebuttal Testimony 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 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.*

85. Prepared Direct Testimony on behalf of the **Solar** Energy Industries Association (A. 15-04-012—July 5, 2016)

    - *Selection of Time-of-Use periods, and rate design issues for solar customers.*

86. Prepared Direct Testimony on behalf of the **Solar** Energy Industries Association (A. 16-09-003 — April 28, 2017)

    - *Selection of Time-of-Use periods, and rate design issues for solar customers.*

87. Prepared Direct Testimony on behalf of the **Solar** Energy Industries Association (A. 17-06-030 — March 23, 2018)

    - *Selection of Time-of-Use periods, and rate design issues for solar customers.*

EXPERT WITNESS TESTIMONY BEFORE THE ARIZONA CORPORATION COMMISSION

1. Prepared Direct, Rebuttal, and Supplemental Testimony on behalf of **The Alliance for Solar Choice (TASC)**, (Docket No. E-00000J-14-0023, February 27, April 7, and June 22, 2016).

   - *Development of a benefit-cost methodology for distributed, net metered solar resources in Arizona.*

2. Prepared Surrebuttal and Responsive Testimony on behalf of the **Energy Freedom Coalition of America** (Docket No. E-01933A-15-0239 – March 10 and September 15, 2016).

   - *Critique of a utility-owned solar program; comments on a fixed rate credit to replace net energy metering.*

3. Direct Testimony on behalf of the **Solar Energy Industries Association** (Docket No. E-01345A-16-0036, February 3, 2017).

4. Direct and Surrebuttal Testimony on behalf of **The Alliance for Solar Choice and the Energy Freedom Coalition of America** (Docket Nos. E-01933A-15-0239 (TEP), E-01933A-15-0322 (TEP), and E-04204A-15-0142 (UNSE) – May 17 and September 29, 2017).

EXPERT WITNESS TESTIMONY BEFORE THE COLORADO PUBLIC UTILITIES COMMISSION

1. Direct Testimony and Exhibits 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 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.*

3. Answer Testimony and Exhibits, plus Opening Testimony on Settlement, on behalf of the **Solar Energy Industries Association**, (Docket No. 16AL-0048E [Phase II] – June 6 and September 2, 2016).

   - *Rate design issues related to residential customers and solar distributed generation in a Public Service of Colorado general rate case.*

EXPERT WITNESS TESTIMONY BEFORE THE GEORGIA PUBLIC SERVICE COMMISSION

1. Direct Testimony on behalf of **Georgia Interfaith Power & Light and Southface Energy Institute, Inc.** (Docket No. 40161 – May 3, 2016).

   - *Development of a cost-effectiveness methodology for solar resources in Georgia.*

EXPERT WITNESS TESTIMONY BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

1. Direct Testimony 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 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 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.*

2. a. Direct Testimony on behalf of the **Sierra Club** (Case No. IPC-E-17-13 — December 22, 2017)
   b. Rebuttal Testimony on behalf of the **Sierra Club** (Case No. IPC-E-17-13 — January 26, 2018)

EXPERT WITNESS TESTIMONY BEFORE THE MASSACHUSETTS DEPARTMENT OF PUBLIC UTILITIES

1. Direct and Rebuttal Testimony on behalf of **Northeast Clean Energy Council, Inc.** (Docket D.P.U. 15-155, March 18 and April 28, 2016)

   - *Residential rate design and access fee proposals related to distributed generation in a National Grid general rate case.*

EXPERT WITNESS TESTIMONY BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

1. Prepared Direct Testimony on behalf of Vote Solar (Case No. U-18419—January 12, 2018)

2. Prepared Rebuttal Testimony on behalf of the **Environmental Law and Policy Center, the Ecology Center, the Solar energy Industries Association, Vote Solar, and the Union of Concerned Scientists** (Case No. U-18419 — February 2, 2018)

EXPERT WITNESS TESTIMONY BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

1. Direct and Rebuttal Testimony 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 MONTANA PUBLIC SERVICE COMMISSION

1. Pre-filed Direct and Supplemental Testimony on Behalf of **Vote Solar and the Montana Environmental Information Center** (Docket No. D2016.5.39,October 14 and November 9, 2016).

   - *Avoided cost pricing issues for solar QFs in Montana.*

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.*

4. a. Prepared Direct Testimony on behalf of **The Alliance for Solar Choice (TASC),** (Docket Nos. 15-07041 and 15-07042 –October 27, 2015).
   b. Prepared Direct Testimony on Grandfathering Issues on behalf of **TASC,** (Docket Nos. 15-07041 and 15-07042 –February 1, 2016).

c. Prepared Rebuttal Testimony on Grandfathering Issues on behalf of **TASC**, (Docket Nos. 15-07041 and 15-07042 –February 5, 2016).

- *Net energy metering and rate design issues in Nevada.*

EXPERT WITNESS TESTIMONY BEFORE THE NEW HAMPSHIRE PUBLIC UTILITIES COMMISSION

1. Prepared Direct and Rebuttal Testimony on behalf of **The Alliance for Solar Choice (TASC)**, (Docket No. DE 16-576, October 24 and December 21, 2016).

   - *Net energy metering and rate design issues in New Hampshire.*

EXPERT WITNESS TESTIMONY BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

1. Direct Testimony 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.*

2. Direct Testimony and Exhibits 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 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.*

3. Direct Testimony on Behalf of the **Oregon Solar Energy Industries Association** (UM 1910, 1911, and 1912 — March 16, 2018).

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA

1. Direct Testimony and Exhibits 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 UTILITIES COMMISSION OF TEXAS

1. Direct Testimony on behalf of the **Solar Energy Industries Association** (SEIA) (Docket No. 44941 – December 11, 2015)

   - *Rate design issues concerning net metering and renewable distributed generation in an El Paso Electric general rate case.*

EXPERT WITNESS TESTIMONY BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

1. Direct Testimony 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 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.

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Exhibit A

Jeffrey T. Thomas

I graduated from the University of Illinois Champaign-Urbana in 2009, earning a Bachelor of Science Degree in General Engineering. Afterwards, I worked in various operations management roles for General Electric, United Technologies Corporation, and Danaher Corporation. Originally a manufacturing and process engineer in GE's Operations Management and Leadership program, I eventually became a production supervisor, where I was responsible for the safety and productivity of a team of employees. I left manufacturing in 2015 to attend North Carolina State University, earning a Master of Science degree in Environmental Engineering. At NC State, I performed cost benefit analysis research on smart grid components at the Future Renewable Energy Electricity Delivery and Management Systems Engineering Research Center. My master's thesis focused on electric power system modeling, capacity expansion planning, linear programming techniques, and the effect of various state and national energy policies on North Carolina's generation portfolio and electricity costs. After obtaining my degree, I joined the Public Staff in November 2017. In my current role, I have filed testimony in CPCN proceedings, and have been involved in the implementation of HB 589 programs, utility cost recovery, renewable energy program management, customer complaints, and other aspects of utility regulation.

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Public Staff - Thomas Testimony
Exhibit B

Utility	Study Year	Resource	Modeled as Island? [1]	Model Time Steps (min)	System Size (MW)	Intermittent Capacity (MW)	Intermittent Penetration (%)	Integration Charge ($/MWh)	Link
DEC	2018	Solar	Yes	5	18,136	840	5%	$1.10	
					18,136	1520	8%	$1.37	
DEP	2018	Solar	Yes	5	14,011	2950	21%	$2.39	
					14,011	3110	22%	$2.64	
Idaho Power	2016	Solar	Yes [3]	5	5,475	400	7%	$0.27	http://www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE1611/20160506SOLAR%20INTEGRATION%20STUDY%20REPORT.PDF
					5,475	800	15%	$0.57	
					5,475	1200	22%	$0.69	
					5,475	1600	29%	$0.85	
Idaho Power	2013	Wind	Yes	5	3,245	800	25%	$8.06	http://www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE1611/20160506SOLAR%20INTEGRATION%20STUDY%20REPORT.PDF
					3,245	1000	31%	$13.03	
					3,245	1200	37%	$19.01	
South Carolina Electric & Gas Company	2019	Solar	Yes	5	5,000	336	7%	$3.52	South Carolina PUC Docket No. 2019-2-E Direct Testimony of Matthew W. Tanner Filed February 8, 2019
					5,000	637	13%	$4.04	
					5,000	1044	21%	$3.96	
Arizona Public Service	2012	Solar	Yes	10	9,283	1038	11%	$1.62	https://www.eslg.energy/resources/aps-solar-photovoltaic-pv-integration-cost-study/
					13,007	1669	13%	$2.67	
Public Service Company of Colorado	2016	Solar	Unclear	60	7,000	1000	14%	$0.01	https://www.xcelenergy.com/staticfiles/xe/PDF/Attachment%20KLS-1.pdf
					7,000	1800	26%	$0.41	
Public Service Company of Colorado	2013	Solar	Unclear	60	7,000	117	2%	$0.50	http://www.eei.org/issuesandpolicy/generation/NetMetering/Documents/Costs%20and%20Benefits%20of%20Distributed%20Solar%20Generation%20on%20the%20Public%20Service%20Company%20of%20Colorado%20System%20Xcel%20Energy.pdf
					7,000	117	2%	$1.80	
					7,000	117	2%	$4.40	
Public Service Company of Colorado	2011	Wind	Unclear	60	7,035	1414	20%	$2.39	https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/11M-710E_2G-3GReport_Final.pdf
					7,035	1939	28%	$3.40	
					7,035	2999	43%	$4.02	

Notes

[1] Modeling as an "island" may still allow purchases to meet capacity shortfalls, but if the system cannot rely on outside market purchases to compensate for intermittent generation shortfalls, it is considered an "island".
[2] Shaded cells represent total ancillary reserves, not incremental
[3] This study looked at the possible effect of an Energy Imbalance Market as a sensitivity

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Public Staff - Thomas Testimony
Exhibit C

LOLE FLEX Starting Point/Benchmarking

2015 Historical Data shows average 60 minute load following supplied to be 1,663.0 MW (See Duke Load Following Calcs - 2015 for Staff.xls) versus 1,600.0 MW as the starting point in the Astrape modeled results. Astrape believes the 0.1 is more supportive of historical operations

Ancillary Service Costs for Existing Plus Transition maintaining different LOLE Flex values (.1, .3, and 1)

DEC		Base Case .1 LOLE Flex	Post Processing - Estimated .3 LOLE Flex	Post Processing - Estimated 1 LOLE Flex
Starting Spin/Load Following Supplied	MW	1,005	965	959
Average Ancillary Service Costs (Existing Plus Transition)	$/MWh	1.10	1.06	1.03
Existing Plus Transition - incremental load following	MW	26.24	26.00	25.95

DEP		Base Case .1 LOLE Flex	Post Processing - Estimated .3 LOLE Flex	Post Processing - Estimated 1 LOLE Flex
Starting Spin/Load Following Supplied	MW	594	579	575
Average Ancillary Service Costs (Existing Plus Transition)	$/MWh	2.39	2.35	2.35
Existing Plus Transition - incremental load following	MW	165.84	151.30	146.60

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Exhibit D

CPRE PPA (6/8/18)
Energy Storage Protocol

1. The Storage Resource must be on the DC side of the inverter and charged exclusively by the Facility.

2. The Storage Resource will be controlled by the Seller, within operational limitations described below.

3. The maximum output of the Facility, including any storage capability, at any given time shall be limited to the Facility's maximum Nameplate Capacity Rating (AC) as specified in the Agreement.

4. The Seller may not increase the Facility's Capacity, including any DC Nameplate Capacity Rating (MW) or AC Nameplate Capacity Rating (MW) or Storage Resource capacity (MW/MWh) beyond what is specified in the Agreement.

5. The discharge of stored energy is not permitted while the Facility has received or is subject to a Dispatch Down instruction or control signal from the System Operator.

6. Ramp rates for Storage Resource shall not exceed 5 percent of the Facility's Nameplate Capacity Rating on a per minute basis, whether up or down, at any time that the Facility is not generating.

7. When the Facility is generating, the Storage Resource shall not act to increase the net ramp rate of the Facility by more than 1 percent of the Facility's Nameplate Capacity Rating per minute in relation to the output from the Facility alone, over a one minute interval, up or down.

8. Scheduling and other storage limitations:
    a. Seller shall, by 8am each day, provide a day-ahead forecast of planned initial state of energy storage (MWh) and planned charging (MWh) of storage for each hour.
    b. By 4pm each day, Buyer will make commercially reasonable efforts to provide Seller with a window for bulk discharge with start and end times for the following day, including off-peak days.
        i. Outside of the bulk discharge window, discharge of the Storage Resource will not be permitted until the Storage Resource reaches and remains at a state of charge of at least 70% of the Allowable Depth of Discharge (as defined below).

ii. During on-peak days, the bulk discharge window will be entirely contained within the respective on-peak hours.
iii. Buyer will make commercially reasonable efforts to provide a minimum of 3 hours to discharge remaining battery capacity within each on-peak period.
iv. The discharge rate (in MW) shall be levelized across the bulk discharge window except as limited by ramp rate criteria or inverter capability.
v. For non-summer periods, if the bulk discharge window is not long enough to empty the battery before solar generation is expected to be at full output, the bulk discharge window may be moved up to allow full storage discharge within the on-peak window.

c. The storage charging (Active Power) when the Storage Resource is not inverter limited, shall be limited to 30% of a Facility's storage Allowable Depth of Discharge (e.g., a 10MWh battery with an Allowable Depth of Discharge of 8MWh could charge Active Power at a maximum of 2.4MW).

9. Buyer reserves the right to add or modify operating restrictions specified in these Energy Storage Protocols to the extent necessary to comply with NERC Standards as such standards may be modified from time to time during the Term. Any such modification shall be implemented by Buyer in a Commercially Reasonable Manner and shall be applied to the Facility and Buyer's own generating assets on a non-discriminatory basis. If Seller can make a Commercially Reasonable Demonstration to Buyer, which is approved by Buyer in its reasonable discretion that the Facility does not contribute to potential NERC compliance violations for which the modifications have been implemented, then such modifications shall not apply to the Facility.

10. Seller will only be compensated for Energy and Capacity actually provided to Buyer in accordance with the terms of the Agreement.

Notes:

a) For facilities equipped with energy storage devices, Seller shall be required to provide the "Nameplate Capacity Ratings" for the Facility in both AC and DC and include in Exhibit 4.
b) The storage device capacity (MW and MWh) shall be specified in Exhibit 4.

Definitions:

"Allowable Depth of Discharge" shall mean the MWh energy storage potential, considering the original equipment manufacturer's recommendations and any emergent operating limitations, at a given point in time.
Other capitalized terms used in this Exhibit which have not been defined herein shall have the meaning ascribed to such terms in the Agreement to which this exhibit is attached.

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Exhibit E

Schedule PP PPA
Energy Storage Protocol

1. The Storage Resource must be on the DC side of the inverter and charged exclusively by the Facility.

2. The Storage Resource will be controlled by the Seller, within operational limitations described below.

3. The maximum output of the Facility, including any storage capability, at any given time shall be limited to the Facility's Contract Capacity as specified in the Agreement.

4. The discharge of stored energy is not permitted while the Facility has received or is subject to a curtailment instruction (i.e., System Operator Instruction) from the system operator.

5. Ramp rates for Storage Resource shall not exceed 10 percent of the Storage Resource's capacity (MW) on a per minute basis, whether up or down, at any time that the Facility is not generating, unless the system operator has waived this ramping limitation.

6. When the Facility is generating, the Storage Resource shall not act to increase the net ramp rate of the Facility by more than 5 percent of the Storage Resource's capacity (MW) per minute in relation to the output from the Facility alone, over a one-minute interval, up or down, unless the system operator has waived this ramping limitation.

7. Scheduling and other storage limitations:
   a. For all months/days with Premium Peak (as defined in the Proposed Settlement) windows, the Seller shall distribute any discharge of the storage device in a manner that levellzes (holds constant) the combined output of solar and storage at the highest practical level during the Premium Peak hours of such calendar day, except as limited by ramp rate criteria and inverter capability.
      i. For any storage discharge occurring on weekends and holidays where only Off-Peak energy rates apply, the Seller shall apply the same discharge logic that is applied to Weekdays/non-Holidays, for the respective month.
      ii. If the storage device is AC (MW) limited, discharge may begin prior to the Premium Peak window to allow the storage device to reach its Allowable Depth (as defined below) of Discharge.

b. For the remaining months without Premium Peak windows, the Seller shall distribute any discharge of the storage device in a way that levelizes (holds constant) the combined output of solar and storage at the highest practical level during three consecutive hours beginning with the hour of sunset.
    i. If the storage device is AC (MW) limited, discharge may continue beyond the three-hour window until the storage device reaches its Allowable Depth of Discharge.

8. Company reserves the right to add or modify operating restrictions specified in these Energy Storage Protocols to the extent necessary to comply with NERC Standards as such standards may be modified from time to time during the Term. Any such modification shall be implemented by Company in a Commercially Reasonable Manner and shall be applied to the Facility and Company's own generating assets on a non-discriminatory basis. If Seller can make a commercially reasonable demonstration to Company, which is approved by Company in its reasonable discretion that the Facility does not contribute to potential NERC compliance violations for which the modifications have been implemented; then such modifications shall not apply to the Facility.

9. Seller will only be compensated for Energy and Capacity actually provided to Buyer in accordance with the terms of the Agreement.

Notes:
a) "Allowable Depth of Discharge" shall mean the MWh energy storage potential, considering the original equipment manufacturer's recommendations and any emergent operating limitations, at a given point in time.
b) Other capitalized terms used in this Exhibit which have not been defined herein shall have the meaning ascribed to such terms in the Agreement to which this exhibit is attached.
c) Terms above assume conditions ascribed in the current Proposed Rate Design Settlement as of March 14th, 2019 (the "Proposed Settlement").

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Exhibit F

NC Public Staff
Docket No. E-100, Sub 158
2018 Avoided Cost Rates
Joint Data Request No. 14
Item No. 14-15

DUKE ENERGY PROGRESS, LLC and DUKE ENERGY CAROLINAS, LLC

Request:

Please describe the rationale for choosing the specific ramp rate constraint percentages of 5% of Facility's Nameplate Capacity (for CPRE) and 10% of Storage Resource Capacity (for Schedule PP).

Response:

When evaluating ramp limits for Tranche 1 of CPRE, the Companies decided to limit the ramp in a manner consistent with industry standard limits for ramping in power market purchase schedules. The current industry standard is a 10% ramp for a schedule from start to full schedule quantity (over a 10-minute period). Similarly, with Tranche 1, the Companies determined that a 5% limit on ramp of the solar facility ("Facility") would be approximate to a 10% ramp of a storage resource. The Companies' initial assumption was that a bid with a Facility might add a storage resource that was equal to 25% to 50% of the Facility capacity. For example, an 80 MW Facility would add a 20 MW or 40 MW storage resource. In this example, if the 40 MW storage resource was added, then the ramp rate limit of 5% of Facility would provide for 4 MW/Minute of ramp. This would allow the storage resource to discharge the full capacity (40 MW) in 10 minutes.

When evaluating the storage protocols for E-100 Sub 158, it was decided to tie the ramp directly to the storage resource that would be charging/discharging in keeping with efforts to streamline the Schedule PP Storage Protocols language. Therefore, it was decided to use a ramp limit of 10% of the storage resource.

-/A
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Exhibit G

Proposed revision to Commission Rule R8-64(b)(6)(iii):

The projected annual hourly production profile for the first full year of operation of the renewable energy facility in kilowatt-hours, including an explanation of potential factors influencing the shape of the production profile, including fixed tilt or tracking panel arrays, inverter loading ratio, over-paneling, clipped energy, or inverter AC output power limits ~~A detailed explanation of the anticipated kilowatt and kilowatthour outputs, on-peak and off-peak, for each month of the year. The explanation shall include a statement of the specific on-peak and off-peak hours underlying the applicant's quantification of anticipated kilowatt and kilowatt-hour outputs~~;

Proposed revision to Commission Rule R8-71(k)(2)(iii)(6):

The projected annual hourly production profile for the first full year of operation of the renewable energy facility in kilowatt-hours, including an explanation of potential factors influencing the shape of the production profile, including fixed tilt or tracking panel arrays, inverter loading ratio, over-paneling, clipped energy, or inverter AC output power limits ~~including a detailed explanation of the anticipated kilowatt and kilowatt-hour outputs, on-peak and off-peak, for each month of the year~~; and .