INFORMATION SHEET

PRESIDING: Commissioner Clodfelter; Chairman Finley and Commissioners Brown-Bland, Dockham, Patterson, Gray and Mitchell
PLACE: Dobbs Building, Room 2115, Raleigh, NC
DATE: September 18, 2018
TIME: 9:40 a.m. – 9:47 a.m.
DOCKET NO.: E-2, Sub 1175
COMPANY: Duke Energy Progress, LLC
DESCRIPTION: Application for Approval of Renewable Energy and Energy Efficiency Portfolio Standard Cost Recovery Rider Pursuant to G.S. 62-133.8 and NCUC Rule R8-67.
VOLUME:

APPEARANCES
DUKE ENERGY PROGRESS, LLC:
Robert W. Kaylor, Esq.
Kendrick Fentress, Esq.

FOR CAROLINA UTILITY CUSTOMERS ASSOCIATION, INC.:
Robert F. Page, Esq.

FOR NORTH CAROLINA SUSTAINABLE ENERGY ASSOCIATION:
Benjamin Smith, Esq.

FOR THE USING AND CONSUMING PUBLIC:
Tim Dodge, Esq., Public Staff

WITNESSES
Prefiled Testimony and Affidavits of:

Veronica I. Williams	Megan Jennings
Jay B. Lucas	Michelle Boswell

EXHIBITS

See attached.

TRANSCRIPT ORDERED BY: Fentress, Smith and Dodge
OFFICIAL CONFIDENTIAL EXHIBITS ORDERED BY: Fentress, Smith and Dodge

REPORTED BY: Kim Mitchell	TRANSCRIPT PAGES:	17
TRANSCRIBED BY: Kim Mitchell	PREFILED PAGES:	58
DATE TRANSCRIBED: October 2, 2018	TOTAL PAGES:	75

PLACE: Dobbs Building, Raleigh, North Carolina

DATE: Tuesday, September 18, 2018

TIME: 9:40 a.m. - 9:47 a.m.

DOCKET NO: E-2, Sub 1175

BEFORE: Commissioner Daniel G. Clodfelter, Presiding
Chairman Edward S. Finley, Jr.
Commissioner ToNola D. Brown-Bland
Commissioner Jerry C. Dockham
Commissioner James G. Patterson
Commissioner Lyons Gray
Commissioner Charlotte A. Mitchell

IN THE MATTER OF:

Application of Duke Energy Progress, LLC, for Approval of Renewable Energy and Energy Efficiency Portfolio Standard Cost Recovery Rider Pursuant to G.S. 62-133.8 and Commission Rule R8-67.

A P P E A R A N C E S:

FOR DUKE ENERGY PROGRESS, LLC:

Kendrick C. Fentress, Esq.
Associate General Counsel
401 Wilmington Street
Raleigh, North Carolina 27601

Robert W. Kaylor, Esq.
Law Office of Robert W. Kaylor, P.A.
353 E. Six Forks Road, Suite 260
Raleigh, North Carolina 27609

FOR NORTH CAROLINA SUSTAINABLE ENERGY ASSOCIATION:

Benjamin Smith, Esq.
Regulatory Counsel
4600 Six Forks Road, Suite 300
Raleigh, North Carolina 27609

FOR CAROLINA UTILITY CUSTOMERS ASSOCIATION, INC.:

Robert F. Page, Esq.
Crisp & Page, PLLC
4010 Barrett Drive, Suite 205
Raleigh, North Carolina 27609

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

FOR THE USING AND CONSUMING PUBLIC:

Tim R. Dodge, Esq.

Public Staff - North Carolina Utilities Commission

4326 Mail Service Center

Raleigh, North Carolina 27699-4300

TABLE OF CONTENTS

EXAMINATIONS:

E X H I B I T S

(All Confidential Exhibits are filed under seal.)

NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE Sept 18, 2018
DOCKET #: E-2, Sub 1173, 1175
NAME OF ATTORNEY Robert W. Kaylor
TITLE Attorney
FIRM NAME Robert W. Kaylor, P.A.
ADDRESS 353 E. Six Forks Rd., STE 260
CITY Raleigh NC
ZIP 27609

APPEARING FOR: Duke Energy Progress, LLC

APPLICANT ✓ COMPLAINANT _____ INTERVENO R _____
PROTESTANT _____ RESPONDENT _____ DEFENDANT _____

PLEASE NOTE: Electronic Copies of the regular transcript can be obtained from the NCUC website at HTTP://NCUC.commerce.state.nc.us/docksr ch.html under the respective docket number.

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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE 9/18/18
DOCKET #: E-2 Sub 1175
NAME OF ATTORNEY Kendrick Fentress
TITLE Associate General Counsel
FIRM NAME Duke Energy
ADDRESS 410 Wilmington St.
CITY Raleigh NC
ZIP 27601

APPEARING FOR: Duke Energy Progress

APPLICANT ✓ COMPLAINANT _____ INTERVENO R _____
PROTESTANT _____ RESPONDENT _____ DEFENDANT _____

PLEASE NOTE: Electronic Copies of the regular transcript can be obtained from the NCUC website at HTTP://NCUC.commerce.state.nc.us/docksr ch.html under the respective docket number.

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Email: Kendrick.Fentress@duke-energy.com
(Required for distribution)

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Signature: [signature]
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NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE 09/18/18 DOCKET #: E-2, Sub 1175
NAME AND TITLE OF ATTORNEY Robert F. Page
FIRM NAME Crisp & Page, PLLC
ADDRESS 4010 Barrett Dr., Suite 205
CITY Raleigh ZIP 27609

APPEARING FOR: Carolina Utility Customers Association, Inc.

APPLICANT _____ COMPLAINANT _____ INTERVENER ✓
PROTESTANT _____ RESPONDENT _____ DEFENDANT _____

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Phone #: _____
Email: _____

Signature: _____

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Signature: _____

NORTH CAROLINA UTILITIES COMMISSION
APPEARANCE SLIP

DATE September 18, 2018
DOCKET #: E-2, Sub 1173, E-2, Sub 1174, E-2, Sub 1175
NAME OF ATTORNEY Benjamin Smith
TITLE Regulatory Counsel for NCSEA
FIRM NAME
ADDRESS 4800 Six Forks Road, Suite 300
CITY Raleigh
ZIP 27609

APPEARING FOR: North Carolina Sustainable Energy Association

APPLICANT _____ COMPLAINANT _____ INTERVENO R ✓
PROTESTANT _____ RESPONDENT _____ DEFENDANT _____

PLEASE NOTE: Electronic Copies of the regular transcript can be obtained from the NCUC website at HTTP://NCUC.commerce.state.nc.us/docksr ch.html under the respective docket number.

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NORTH CAROLINA UTILITIES COMMISSION
PUBLIC STAFF - APPEARANCE SLIP

DATE September 18, 2018 DOCKET #: E-2, Sub 1175

PUBLIC STAFF MEMBER Tim R. Dodge

ORDER FOR TRANSCRIPT OF TESTIMONY TO BE **EMAILED** TO THE PUBLIC STAFF - PLEASE INDICATE YOUR DIVISION AS WELL AS YOUR EMAIL ADDRESS BELOW:

ACCOUNTING _____
WATER _____
COMMUNICATIONS _____
ELECTRIC _____
GAS _____
TRANSPORTATION _____
ECONOMICS _____
LEGAL tim.dodge@psncuc.nc.gov
CONSUMER SERVICES _____

PLEASE NOTE: Electronic Copies of the regular transcript can be obtained from the NCUC web site at HTTP://NCUC.commerce.state.nc.us/docksrch.html under the respective docket number.

1 Number of copies of confidential portion of regular transcript (assuming a confidentiality agreement has been signed). Confidential pages will still be received in paper copies.

***PLEASE INDICATE BELOW WHO HAS SIGNED A CONFIDENTIALITY AGREEMENT. IF YOU DO NOT SIGN, YOU WILL NOT RECEIVE THE CONFIDENTIAL PORTIONS!!!!

- Tim Dodge

Signature of Public Staff Member

1A

REDACTED VERSION

DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175
Compliance Costs for the EMF Period April 1, 2017 to March 31, 2018

Williams Exhibit No. 1

June 20, 2018

Line No.	Renewable Resource	RECs - Jennings Exhibit No. 2	MWh (Energy)	Total Cost - Jennings Exhibit No. 2	Avoided Cost	Incremental Cost	Retail %	REPS Cost - Retail Only	
1	[redacted]						99.77%		
2							99.77%		
3							99.77%		
4							99.77%		
5							99.77%		
6							99.77%		
7							99.77%	$ 40,593,836	
8	Other Incremental cost			$ 1,512,852	Jennings Exhibit No. 2	$ 1,512,852	99.77%	$ 1,509,372	(f)
9	Solar Rebate Program			$ -		$ -	99.77%	$ -	(g)
10	Research			$ 543,992		$ 543,992	99.77%	$ 542,741	(h)
11	**Total**			**$ 242,051,697** Jennings Exhibit No. 2		**$ 42,744,260**		**$ 42,645,949**	(below)

	Incremental cost category	Incremental Cost		Percent of Total Incremental Cost
12	[redacted]			
13				
14	**Total**	**$ 42,645,949**	(above)	**100.00%**

Allocate estimated incremental cost of solar resources between solar compliance requirement and general compliance requirement:

15 [redacted]
16
17
18
19
20

REDACTED VERSION

DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175
Compliance Cost for the Billing Period December 1, 2018 to November 30, 2019

Line No.	Renewable Resource	RECs - Jennings Exhibit No. 2	MWh (Energy)	Total Cost - Jennings Exhibit No. 2	Avoided Cost	Incremental Cost	Retail %	REPS Cost - Retail Only	
1	[redacted]						100.0%		
2							100.0%		
3							100.0%		
4							100.0%		
5							100.0%		
6							100.0%		
7							100.0%		
8							100.0%		
9	Other Incremental cost			$ 1,630,000	Jennings Exhibit No. 2	$ 1,630,000	100.0%	$ 1,630,000	(g)
10	Estimated receipts related to contract performance			$ (650,000)		$ (650,000)	100.0%	$ (650,000)	(h)
11	Solar Rebate Progrmm			$ 1,061,000		$ 1,061,000	100.0%	$ 1,061,000	(i)
12	Research			$ 685,000		$ 685,000	100.0%	$ 685,000	(j)
13	**Total**			**$ 220,952,269** Jennings Exhibit No. 2		**$ 40,959,120**		**$ 40,959,120** [1]	

	Incremental cost category	Incremental Cost - Retail	Percent of Total Incremental Cost
14	[redacted]		
15			
16	**Total**	**$ 40,959,120** [1]	**100.00%**

Allocate estimated incremental cost of solar resources between solar compliance requirement and general compliance requirement:

17	[redacted]
18	
19	
20	
21	
22	

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Oct 05 2018

DUKE ENERGY PROGRESS, LLC — REDACTED VERSION — Williams Exhibit No. 2
Docket No. E-2, Sub 1175 — Page 1 of 2
Compliance Costs for the EMF Period April 1, 2017 to March 31, 2018 — June 20, 2018

Calculate set-aside and other incremental and research cost per customer class - EMF Period:

Line No.	Customer Class	Total Unadjusted Number of Accounts [1]	Annual Rider Cap per Account Type	Calculated Annual Revenue Cap	Cost Cap Allocation Factor	Allocated Annual Set-aside, Other Incremental, and Research Cost
1	Residential	1,201,763	$ 27	$ 32,447,601	51.0%	$ 8,693,609
2	General	195,304	$ 150	$ 29,295,600	46.1%	$ 7,858,342
3	Industrial	1,855	$ 1,000	$ 1,855,000	2.9%	$ 494,343
4	Totals			$ 63,598,201	100.0%	$ 17,046,294

Williams Ex No. 1, Pg 1 Line 12

Calculate general cost per customer class - EMF Period:

Line No.	Customer Class	Number of RECs for General compliance [a]	% of EE REC supplied by Class[2]	REC Requirement supplied by EE by class [3] [b]	Number of General RECs net of EE (c) = (a) - (b)	General Cost Allocation Factor (e) = (c) / (d)	Allocated Annual General Incremental Costs
5	Residential	[redacted]	67.3%	[redacted]		41.0%	$ 10,494,417
6	General		32.3%			54.6%	$ 13,969,991
7	Industrial		0.4%			4.4%	$ 1,135,247
8	Totals		100.0%			100.0%	$ 25,599,655

Williams Ex No. 1, Pg 1 Line 13

Total cost allocation by customer class - EMF Period:

		Total Incremental REPS cost by class	% Incremental REPS cost by class
9	Residential	$ 19,188,026	44.99%
10	General	$ 21,828,333	51.19%
11	Industrial	$ 1,629,590	3.82%
12	Total	$ 42,645,949	100.00%

Williams Ex. No. 1 Pg 1 Line No. 14

Notes:

(1) Average monthly number of REPS accounts for the EMF Period.

(2) EE allocated to account type according to actual relative contribution of EE RECs by customer class.

(3) Limited to 25% of total RECs

[redacted]

Calculate incremental cost under/(over) collection per customer class - EMF Period:

Line No.	Account Type	Allocated Annual Set-aside and Other Incremental costs	Allocated Annual General Incremental Costs	Total Incremental Costs	Actual NC Retail REPS Revenues Realized - EMF Period	Annual REPS EMF - Under/(Over)-Collection, before Interest	Interest on Over-collection[1]	Annual REPS EMF - Under/(Over)-Collection
1	Residential	$ 8,693,609	$ 10,494,417	$ 19,188,026	$ 17,063,809	$ 2,124,217	$ -	$ 2,124,217
2	General	$ 7,858,342	$ 13,969,991	$ 21,828,333	$ 22,918,939	$ (1,090,606)	$ (181,768)	$ (1,272,374)
3	Industrial	$ 494,343	$ 1,135,247	$ 1,629,590	$ 1,432,803	$ 196,787	$ -	$ 196,787
4	**Total**	**$ 17,046,294**	**$ 25,599,655**	**$ 42,645,949**	**$ 41,415,551**	**$ 1,230,398**	**$ (181,768)**	**$ 1,048,630**

<<< Williams Exhibit No. 2 page 1>>>

Notes:

[1] Interest calculated at annual rate of 10% for number months from mid-point of EMF period to mid-point of prospective rider billing period.

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REDACTED VERSION

DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175
Compliance Cost for the Billing Period December 1, 2018 to November 30, 2019

Williams Exhibit No. 3
Page 1 of 2
June 20, 2018

Calculate set-aside and other incremental and research cost per customer class - Billing Period:

Line No.	Customer Class	Total Unadjusted Number of Accounts [1]	Annual Rider Cap per Account Type	Calculated Annual Revenue Cap	Cost Cap Allocation Factor	Allocated Annual Set-aside, Other Incremental, and Research Cost
1	Residential	1,222,685	$ 27	$ 33,012,495	51.1%	$ 10,681,332
2	General	198,691	$ 150	$ 29,803,676	46.1%	$ 9,636,192
3	Industrial	1,831	$ 1,000	$ 1,831,467	2.8%	$ 585,278
4	Totals			$ 64,647,638	100.0%	$ 20,902,802

Williams Ex No. 1, Pg 2 Line 14

Calculate general cost per customer class - Billing Period:

Line No.	Customer Class	Number of RECs for General compliance [a]	% of EE REC supplied by Class [2]	REC Requirement supplied by EE by class [3] [b]	Number of General RECs net of EE (c) = (a) - (b)	General Cost Allocation Factor (e) = (c) / (d)	Allocated Annual General Incremental Costs
5	Residential	[redacted]	67.3%	[redacted]		41.5%	$ 8,323,372
6	General		32.3%			54.3%	$ 10,890,581
7	Industrial		0.4%			4.2%	$ 842,365
8	Totals		100.0%			100.0%	$ 20,056,318

Williams Ex No. 1, Pg 2 Line 15

9	Total Incremental Cost for Retail	$ 40,959,120

Williams Ex No. 1, Pg 2 Line 16

Notes:

(1) Projected average monthly number of REPS accounts for the Billing Period.
(2) EE allocated to account type according to actual relative contribution of EE RECs by customer class.
(3) Limited to 25% of total RECs

[redacted]

Calculate Total cost to collect by Customer Class - Billing Period:

North Carolina Retail Annual Rider Cost by Account Type

Line No.	North Carolina Retail Only - Billing Period	Allocated Annual Set-aside and Other Incremental costs	Allocated Annual General Incremental Costs	Total Incremental Costs
1	Residential	$ 10,681,332	$ 8,323,372	$ 19,004,704
2	General	$ 9,636,192	$ 10,890,581	$ 20,526,773
3	Industrial	$ 585,278	$ 842,365	$ 1,427,643
4	**Total**	**$ 20,902,802**	**$ 20,056,318**	**$ 40,959,120**
		Williams Exhibit No. 3, Pg 1, line 4	**Williams Exhibit No. 3, Pg 1, line 8**	**Williams Exhibit No. 3, Pg 1, line 9**

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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175
DEP REPS Billing Components proposed to be effective December 1, 2018 - November 30, 2019

Williams Exhibit No. 4
Page 1 of 1
June 20, 2018

Calculate DEP NC Retail monthly REPS rider components:

Line No.	Customer Class	Total Projected Number of Accounts - DEP NC Retail[1]	Annual REPS EMF Under/(Over)-Collection	Contract Amendments, Penalties, Change-of-control, Etc.[2]	Total EMF costs/(credits)	Monthly EMF Rider	Projected Total Billing Period Incremental Costs	Monthly REPS Rider
1	Residential	1,222,685	$ 2,124,217	$ (325,340)	$ 1,798,877	$ 0.12	$ 19,004,704	$ 1.30
2	General	198,691	$ (1,272,374)	$ (294,082)	$ (1,566,456)	$ (0.66)	$ 20,526,773	$ 8.61
3	Industrial	1,831	$ 196,787	$ (18,500)	$ 178,287	$ 8.11	$ 1,427,643	$ 64.96
4			**$ 1,048,630**	**$ (637,922)**	**$ 410,708**		**$ 40,959,120**	
			Williams Ex. No. 2, Pg 2				Williams Ex. No. 3, Pg 2	

Compare total annual REPS charges per account to per-account cost caps:

	Customer Class	Monthly EMF Rider	Monthly REPS Rider - 12 months	Combined Monthly Rider - 12 months	Regulatory Fee Multiplier	Rider including Regulatory Fee	REPS Rider including Regulatory Fee	Combined Monthly Rider including Regulatory Fee	Combined Annual Rider including Regulatory Fee	2017 Annual Per-Account Cost Cap
5	Residential	$ 0.12	$ 1.30	$ 1.42	1.001402	$ 0.12	$ 1.30	$ 1.42	$ 17.04	$ 27.00
6	General	$ (0.66)	$ 8.61	$ 7.95	1.001402	$ (0.66)	$ 8.62	$ 7.96	$ 95.52	$ 150.00
7	Industrial	$ 8.11	$ 64.96	$ 73.07	1.001402	$ 8.12	$ 65.05	$ 73.17	$ 878.04	$ 1,000.00

Notes:

(1) Projected average monthly number of REPS accounts for the Billing Period.

(2) Forward EMF Period receipts for contract amendments, penalties, change-of-control, etc

Customer Class	Contract receipts credited by customer class	NC retail portion of EMF Period costs - Williams Exhibit No. 1, Pg 1	Allocation to customer class - Williams Exhibit No. 2, Pg 1	Receipts for contract amendments, penalties, change-of-control, etc.
Residential			51.00%	$ (325,340)
General			46.10%	$ (294,082)
Industrial			2.90%	$ (18,500)
Total contract payments received - EMF Period	$ (639,200)	$ (637,922)	100.00%	$ (637,922)
	Jennings Exhibit No. 2	99.80%		

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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Williams Exhibit No. 5
Page No. 1 of 2
June 20, 2018

Worksheet detailing energy efficiency certificate ("EEC") inventory

	EECs	Reference
EEC balance at Dec 31, 2011	599,706	2011 Compliance Report - Docket No. E-2, Sub 1020
EECs generated for 2012 per Company's annual update	14,186	2012 Compliance Report - Docket No. E-2, Sub 1032
Less: EECs used for compliance for 2012	280,150	Company workpapers
EECs carried forward at Dec 31, 2012	333,742	2012 Compliance Report - Docket No. E-2, Sub 1032
EECs generated for 2013 per Company's annual update	392,996	2012 Compliance Report - Docket No. E-2, Sub 1043
Less: EECs used for compliance for 2013	274,420	Company workpapers
EECs carried forward at Dec 31, 2013	452,318	2012 Compliance Report - Docket No. E-2, Sub 1043
EECs generated for 2014 per Company's annual update	479,942	Company workpapers
Less: EECs used for compliance for 2014	276,649	2014 Compliance Report - Docket No. E-2, Sub 1071
EECs carried forward at Dec 31, 2014	655,611	2014 Compliance Report - Docket No. E-2, Sub 1071
EECs generated for 2015 per Company's annual update	1,682,467	Company workpapers
EEC inventory balance adjustment to recognize perpetual savings	1,966,773	Company workpapers
EEC inventory balance 2015 adjustment for EM&V results	4,506	Company workpapers
Less: EECs used for compliance for 2015	562,361	2015 Compliance Report - Docket No. E-2, Sub 1109
EECs carried forward at Dec 31, 2015	3,746,996	2015 Compliance Report - Docket No. E-2, Sub 1109
EECs generated for 2016 per Company's annual update	1,854,388	Company workpapers
EEC inventory balance adjustment - conversion to measure life	(123,943)	Company workpapers
EEC inventory balance 2016 adjustment for EM&V results	(83,074)	Company workpapers
Less: EECs used for compliance for 2016	561,829	2016 Compliance Report - Docket No. E-2, Sub 1144
EECs carried forward at Dec 31, 2016	4,832,538	2016 Compliance Report - Docket No. E-2, Sub 1144
EECs generated for 2017 per Company's annual update	2,026,234	Company workpapers [(a)]
EEC inventory balance 2017 adjustment for EM&V results	(61,225)	Company workpapers
Less: EECs used for compliance for 2017	559,087	2017 Compliance Report - Docket No. E-2, Sub 1175
EECs carried forward at Dec 31, 2017	6,238,460	2017 Compliance Report - Docket No. E-2, Sub 1175

Summary workpapers - EECs generated

	Program year							
Update for 2016 EECs generated - as of year-end 2017:	**2008-2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Current view at year-end 2017	576,999	656,838	923,647	1,219,361	1,533,015	1,816,862	2,026,234	8,752,956
Previously reported current view at year-end 2016	576,999	656,838	923,647	1,219,361	1,556,714	1,854,388	[(a)]	6,787,947
Total Adjustments to previously reported results	0	0	0	0	(23,699)	(37,526)		1,965,009
EM&V and participation adjustments (detail below)	-- 0	0	-0	0	(23,699)	(37,526)	-	(61,225)
EECs generated 2017 per current view							[(a)]	2,026,234
EECs entered in NC-RETS for vintage 2017								**1,965,009**

Worksheet detailing energy efficiency certificate ("EEC") inventory

Detail for adjustments applicable to 2008 - 2016 results:

Adjustment type	Program	Program year 2008-2011	2012	2013	2014	2015	2016	Total
EM&V and participation adjustments:								
	Multi-Family Energy Efficiency	-	-	-	-	(501)	(1,620)	(2,121)
	My Home Energy Report	-	-	-	-	(17,361)	(22,920)	(40,281)
	Neighborhood Energy Saver	-	-	-	-	951	1,519	2,470
	Energy Efficiency for Business	-	-	-	-	(4,328)	(7,285)	(11,613)
	Small Business Energy Saver	-	-	-	-	(2,766)	(6,732)	(9,498)
	Energy Efficiency Education	-	-	-	-	306	747	1,053
	Save Energy & Water	-	-	-	-	-	(994)	(994)
	EnergyWise for Business	-	-	-	-	-	(242)	(242)
	Residential New Construction	-	-	-	-	-	2	2
	Home Energy EE	-	-	-	-	-	(1)	(1)
Total Adjustments to previously reported results		-	-	-	-	(23,699)	(37,526)	(61,225)

EM&V reports applicable to results reported above and the time period covered in this docket - filed as Exhibit No. 8 to the testimony of DEP witness Robert Evans in DEP's energy efficiency Docket No. E-2, Sub 1174:

Program Name As Filed	Docket	Report Reference	Effective Date
EnergyWise	E-2, Sub 927	EM&V Report for the EnergyWise Home Program Summer 2016	6/5/2017
Small Business Energy Saver	E-2, Sub 1022	EM&V Report for the Small Business Energy Saver Program Duke Energy Progress and Duke Energy (	3/1/2016
EnergyWise for Business	E-2, Sub 1086	Duke Energy Carolinas and Progress EnergyWise for Business Programs Evaluation Report	1/1/2016
CIG-DR	E-2, Sub 953	2016 EM&V Report for the Duke Energy Progress Commercial, Industrial, and Governmental Demand	6/19/2017
Multifamily Energy Efficiency Program	E-2, Sub 1059	EM&V Report for the Duke Energy Multifamily Energy Efficiency Program	1/1/2015
EnergyWise	E-2, Sub 927	EM&V Report for the EnergyWise Home Demand Response Program; Winter PY2016/2017	7/6/2017
Energy Efficiency in Education	E-2, Sub 1060	Energy Efficiency Education in Schools Program Year 2015 - 2016 Evaluation Report	1/1/2015
MyHER	E-2,Sub 989	My Home Energy Report Program Evaluation	2/1/2015
Save Energy & Water Kit	E-2,Sub 1085	Save Energy and Water Kits 2016 Program Year Evaluation Report	11/1/2015
Non-Res Prescriptive	E-2, Sub 938	Duke Energy Carolina & Duke Energy Progress Non-Residential Prescriptive Program Evaluation Repo	3/1/2017
Retail Lighting	E-2, Sub 950	Duke Energy Progress & Duke Energy Carolinas Energy Efficiency Lighting & Retail LED Programs E	4/1/2017

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Oct 05 2018

JENNINGS EXHIBIT NO. 1
*****REDACTED VERSION*****

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-2, SUB 1175

In the Matter of	)	
	)	DUKE ENERGY PROGRESS,
Application of Duke Energy Progress, LLC for	)	LLC 2017 RENEWABLE
Approval of Renewable Energy and Energy	)	ENERGY & ENERGY
Efficiency Portfolio Standard Compliance	)	EFFICIENCY PORTFOLIO
Report and Rider Pursuant to N.C. Gen. Stat. §	)	STANDARD COMPLIANCE
62-133.8 and Commission Rule R8-67(c)	)	REPORT

DUKE ENERGY PROGRESS, LLC
RENEWABLE ENERGY AND ENERGY EFFICIENCY
PORTFOLIO STANDARD ("REPS")
COMPLIANCE REPORT

TABLE OF CONTENTS

(A) INTRODUCTION

Duke Energy Progress, LLC ("Duke Energy Progress" or the "Company") submits its Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") Compliance Report ("Compliance Report") in accordance with N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67(c). This Compliance Report provides the required information for the calendar year 2017.[1]

This Compliance Report provides the required information in aggregate for the Company and the following wholesale customers for which the Company provided renewable energy resources and compliance reporting services for 2017: Town of Black Creek, the Town of Lucama, the Town of Sharpsburg, the Town of Stantonsburg, and the Town of Winterville ("Wholesale").

(B) REPS COMPLIANCE REPORT

I. RENEWABLE ENERGY CERTIFICATES:

The table below reflects the renewable energy certificates ("RECs") used to comply with N.C. Gen. Stat. § 62-133.8(d) for the year 2017.

[BEGIN CONFIDENTIAL]

[END CONFIDENTIAL]

[1] Pursuant to NCUC Rule R8-67(c)(1), this Compliance Report reflects Duke Energy Progress' efforts to meet the REPS requirements for the previous calendar year.

II. ACTUAL 2017 TOTAL NORTH CAROLINA RETAIL SALES AND YEAR-END NUMBER OF ACCOUNTS, BY CUSTOMER CLASS:

	2017
NC Retail MWh Sales by Duke Energy Progress	36,829,899
NC Retail MWh Sales by Wholesale	113,174
Total MWh Sales	**36,943,073**

Account Type	Duke Energy Progress Year-end number of Retail Accounts	Wholesale Year-end number of Retail Accounts	Total Year-end number of Retail Accounts
Residential	1,204,664	6,593	1,211,257
General	196,549	626	197,175
Industrial	1,866	8	1,874

III. AVOIDED COST RATES

The avoided cost rates below, applicable to energy received pursuant to power purchase agreements, represent the annualized avoided cost rates in Schedule CSP/PP (NC), Distribution Interconnection, approved in the 2016 avoided cost proceeding Docket E-100, Sub 148, the 2014 avoided cost proceeding Docket No. E-100, Sub 140; the 2012 avoided cost proceeding Docket No. E-100, Sub 136; the 2010 avoided cost proceeding Docket No. E-100, Sub 127; the 2008 avoided cost proceeding Docket No. E-100, Sub 117; and the 2006 avoided cost proceeding Docket No. E-100, Sub 106.

ANNUALIZED CAPACITY AND ENERGY RATES (CENTS PER KWH)						
Docket No.:	**E-100 Sub 148**	**E-100, Sub 140**	**E-100, Sub 136**	**E-100, Sub 127**	**E-100, Sub 117**	**E-100, Sub 106**
Variable Rate	3.35	4.29	4.76	5.79	5.69	4.54
5 Year	n/a	4.42	4.97	6.18	5.82	4.67
10 Year	3.79	5.08	5.47	6.82	6.05	4.85
15 Year	n/a	5.53	5.88	7.29	6.11	4.98

IV. ACTUAL TOTAL AND INCREMENTAL COSTS INCURRED IN 2017

Actual costs incurred in 2017 for REPS compliance were comprised of the following cost of energy purchases and the purchase of various types of RECs and other reasonable and prudent costs incurred to meet the requirements of the statute.

2017 Actual Costs Incurred	Energy and REC Costs	Other	Total Costs
Total costs incurred	$261,272,833	$1,185,415	$262,458,248
Avoided costs	$222,329,270		$22,329,270
Incremental costs	$38,943,563	$1,185,415	$40,128,978

V. ACTUAL INCREMENTAL COSTS COMPARISON TO THE ANNUAL COST CAP AS OF THE PREVIOUS CALENDAR YEAR

Account Type	Total 2016 Year-end number of Retail Accounts[2]	Annual Per-Account Cost Cap	Total Annual Cost Cap
Residential	1,183,723	$27	$31,960,521
General	191,957	$150	$28,793,550
Industrial	1,979	$1,000	$1,979,000
	Total Annual Cost Cap		$62,733,071
	Actual Incremental Costs		$40,128,978

VI. STATUS OF COMPLIANCE WITH REPS REQUIREMENTS

Pursuant to N.C. Gen. Stat. § 62-133.8(b) for Duke Energy Progress Retail and N.C. Gen. Stat. § 62-133.8(c) for the Company's Wholesale REPS customers, the REPS requirement for calendar year 2017 is set at 6% of 2016 North Carolina retail sales. In order to comply with the combined REPS obligation for Duke Energy Progress Retail and its Wholesale REPS customers, the Company submitted 2,210,451 RECs, which included 16,358 Senate Bill 886 ("SB886") RECs, each of which counts for two poultry waste RECs and one general REC. Accordingly, the Company submitted the equivalent of 2,243,167 RECs for compliance, representing 6% of combined 2016 retail megawatt-hour sales of 37,386,080.

[2] Includes number of NC retail accounts for Duke Energy Progress and its Wholesale REPS customers.

Pursuant to N.C. Gen. Stat. § 62-133.8(d), the REPS requirement for calendar year 2017 is at least 0.14% of the total electric power in kilowatt hours sold to retail electric customers in the prior calendar year in the State, or an equivalent amount of energy, shall be supplied by a combination of new solar electric facilities and new metered solar thermal energy facilities. As a result, 52,344 solar RECs were used to meet the Solar Set-Aside Requirement.

In its October 16, 2017 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief* ("2017 Delay Order") in Docket No. E-100, Sub 113, the Commission further delayed for one year the Swine Waste Set-Aside Requirement, which will now commence in compliance year 2018. In addition, the 2017 Delay Order lowered the 2017 Poultry Waste Set-Aside Requirement to 170,000 MWh state-wide, maintaining the same level as the 2016 requirement, and delayed the subsequent increases by one year.

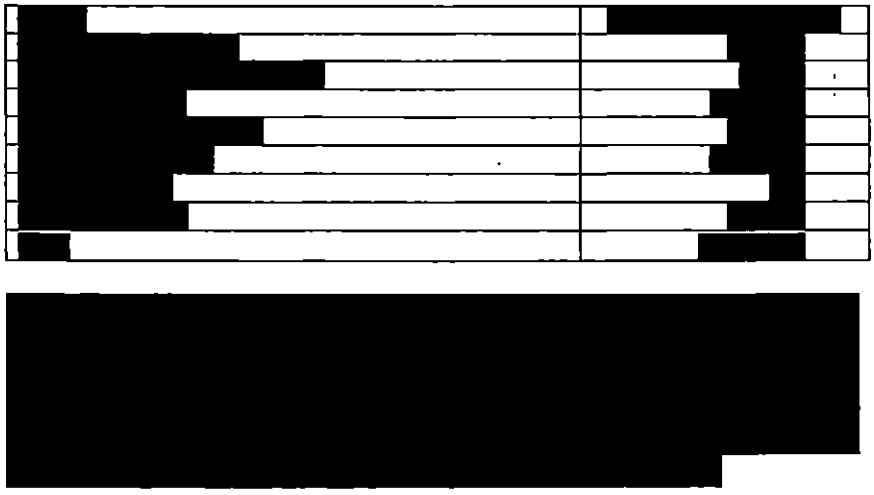
In its August 5, 2016 *Order Establishing 2016, 2017, and 2018 Poultry Waste Set-Aside Requirement Allocation* in Docket No. E-100, Sub 113, the Commission directed the annual aggregate Poultry Waste Set-Aside Requirement to be allocated among electric power suppliers and utility compliance aggregators based on the load ratio share calculations shown on the spreadsheet filed by the NC-RETS Administrator in the same docket on July 11, 2016.

In order to comply with the combined Poultry Waste Set-Aside Requirement allocated to Duke Energy Progress Retail and its Wholesale REPS customers, the Company submitted 15,358 poultry waste RECs along with 16,358 SB886 RECs, which count as 32,716 Poultry Waste Set-Aside RECs. Accordingly, the Company submitted the equivalent of 48,074 poultry RECs for compliance, and met its Poultry Waste Set-Aside Requirement

VII. IDENTIFICATION OF RECs CARRIED FORWARD

The table below reflects the RECs at year-end 2017 that the Company has banked for use in future compliance years.

[BEGIN CONFIDENTIAL]



[END CONFIDENTIAL]

VIII. DATES AND AMOUNTS OF ALL PAYMENTS MADE FOR RENEWABLE ENERGY CERTIFICATES

Confidential Appendix 1 illustrates the dates and amounts of all payments made for renewable energy certificates during calendar year 2017.

(C) METHODOLOGY FOR DETERMINING NUMBER OF CUSTOMERS AND CUSTOMER CAP

Consistent with the Commission's order issued November 12, 2009 in Docket No. E-2, Sub 948, for purposes of REPS billing, the Company defines as a single customer all accounts (metered and unmetered) serving the same customer of the same revenue classification located on the same or contiguous properties. If a customer has accounts which serve in an auxiliary role to a main account on the same premises, no REPS charge applies to the auxiliary accounts, regardless of their revenue classification.

Within the Wholesale group, the Town of Black Creek, the Town of Lucama, the Town of Sharpsburg, the Town of Stantonsburg, and the Town of Winterville each determine the number of accounts for purposes of REPS compliance in the manner such information is reported to the Energy Information Administration for annual electric sales and revenue reporting.

Respectfully submitted this the 20th day of June, 2018.

Kendrick C. Fentress

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Duke Energy Progress, LLC
Docket No. E-2, Sub 1175
2017 REPS Compliance Report
Dates and Amounts of payments for RECs - Calendar Year 2017
Redacted Version*

Jennings Exhibit No. 1
Appendix I
June 20, 2018

Counterparty and Payment Dates		REC Cost
[redacted]		
Apr-2017	$	797.30
Aug-2017	$	1,116.22
Dec-2017	$	318.92
Feb-2017	$	318.92
Jan-2017	$	318.92
Jul-2017	$	1,116.22
Jun-2017	$	956.76
Mar-2017	$	478.38
May-2017	$	956.76
Nov-2017	$	637.84
Oct-2017	$	797.30
Sep-2017	$	956.76
[redacted]		
Apr-2017	$	3,965.22
Aug-2017	$	5,066.67
Dec-2017	$	2,863.77
Feb-2017	$	1,688.89
Jan-2017	$	3,157.49
Jul-2017	$	5,213.53
Jun-2017	$	4,405.80
Mar-2017	$	2,937.20
May-2017	$	4,626.09
Nov-2017	$	3,965.22
Oct-2017	$	4,699.52
Sep-2017	$	3,598.07
[redacted]		
Apr-2017	$	4,914.72
Aug-2017	$	6,962.52
Dec-2017	$	4,607.55
Feb-2017	$	2,559.75
Jan-2017	$	3,890.82
Jul-2017	$	7,064.91
Jun-2017	$	6,041.01
Mar-2017	$	2,969.31
May-2017	$	6,552.96
Nov-2017	$	5,733.84
Oct-2017	$	5,836.23
Sep-2017	$	7,269.69
[redacted]		
Apr-2017	$	413.72
Aug-2017	$	413.72
Dec-2017	$	310.29
Feb-2017	$	206.86
Jan-2017	$	310.29
Jul-2017	$	413.72
Jun-2017	$	413.72
Mar-2017	$	413.72
May-2017	$	413.72
Nov-2017	$	413.72
Oct-2017	$	310.29
Sep-2017	$	413.72
[redacted]		
Apr-2017	$	73.43
Aug-2017	$	73.43
Dec-2017	$	73.43
Feb-2017	$	73.43
Jan-2017	$	73.43
Jul-2017	$	146.86
Jun-2017	$	73.43
Mar-2017	$	73.43

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Counterparty and Payment Dates		REC Cost
May-2017	$	146.86
Nov-2017	$	73.43
Oct-2017	$	146.86
Sep-2017	$	73.43
[redacted]		
Apr-2017	$	1,685.00
Aug-2017	$	2,050.00
Dec-2017	$	1,460.00
Feb-2017	$	1,000.00
Jan-2017	$	1,250.00
Jul-2017	$	1,755.00
Jun-2017	$	1,740.00
Mar-2017	$	1,205.00
May-2017	$	1,920.00
Nov-2017	$	1,595.00
Oct-2017	$	1,940.00
Sep-2017	$	1,815.00
[redacted]		
Apr-2017	$	4,455.00
Aug-2017	$	4,940.00
Dec-2017	$	3,430.00
Feb-2017	$	2,980.00
Jan-2017	$	2,750.00
Jul-2017	$	4,615.00
Jun-2017	$	4,975.00
Mar-2017	$	4,080.00
May-2017	$	4,825.00
Nov-2017	$	3,980.00
Oct-2017	$	4,010.00
Sep-2017	$	4,160.00
[redacted]		
Apr-2017	$	1,752.75
Aug-2017	$	1,887.75
Dec-2017	$	1,269.00
Feb-2017	$	967.50
Jan-2017	$	1,008.00
Jul-2017	$	1,739.25
Jun-2017	$	1,842.75
Mar-2017	$	1,462.50
May-2017	$	1,725.75
Nov-2017	$	1,498.50
Oct-2017	$	1,644.75
Sep-2017	$	1,575.00
[redacted]		
Apr-2017	$	636.75
Aug-2017	$	650.25
Dec-2017	$	510.75
Feb-2017	$	396.00
Jan-2017	$	618.75
Jul-2017	$	711.00
Jun-2017	$	731.25
Mar-2017	$	506.25
May-2017	$	699.75
Nov-2017	$	600.75
Oct-2017	$	409.50
Sep-2017	$	290.25
[redacted]		
Apr-2017	$	6,516.09
Aug-2017	$	8,377.83
Dec-2017	$	4,447.49
Feb-2017	$	2,689.18

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Counterparty and Payment Dates		REC Cost
Jan-2017	$	4,964.64
Jul-2017	$	8,170.97
Jun-2017	$	6,619.52
Mar-2017	$	4,861.21
May-2017	$	7,033.24
Nov-2017	$	6,102.37
Oct-2017	$	6,826.38
Sep-2017	$	7,550.39
[redacted]		
Apr-2017	$	1,835.75
Aug-2017	$	2,056.04
Dec-2017	$	1,395.17
Feb-2017	$	881.16
Jan-2017	$	1,321.74
Jul-2017	$	2,423.19
Jun-2017	$	1,909.18
Mar-2017	$	1,174.88
May-2017	$	1,174.88
Nov-2017	$	1,542.03
Oct-2017	$	2,056.04
Sep-2017	$	2,056.04
[redacted]		
Aug-2017	$	12,189.38
Dec-2017	$	3,010.63
Feb-2017	$	1,982.61
Jan-2017	$	2,423.19
Jun-2017	$	10,353.63
Mar-2017	$	3,818.36
May-2017	$	4,919.81
Nov-2017	$	9,031.89
Sep-2017	$	4,919.81
[redacted]		
Apr-2017	$	3,639.09
Aug-2017	$	3,873.87
Dec-2017	$	3,404.31
Feb-2017	$	1,878.24
Jun-2017	$	1,878.24
Jul-2017	$	3,991.26
Jun-2017	$	3,286.92
Mar-2017	$	1,995.63
May-2017	$	3,639.09
Nov-2017	$	2,582.58
Oct-2017	$	3,873.87
Sep-2017	$	3,991.26
[redacted]		
Apr-2017	$	3,664.00
Aug-2017	$	4,052.00
Dec-2017	$	2,904.00
Feb-2017	$	2,288.00
Jan-2017	$	2,248.00
Jul-2017	$	3,612.00
Jun-2017	$	4,004.00
Mar-2017	$	3,288.00
May-2017	$	3,736.00
Nov-2017	$	3,264.00
Oct-2017	$	3,312.00
Sep-2017	$	2,844.00
[redacted]		
Apr-2017	$	2,637.00
Aug-2017	$	2,955.00
Dec-2017	$	2,079.00

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Counterparty and Payment Dates		REC Cost
Feb-2017	$	1,683.00
Jan-2017	$	1,614.00
Jul-2017	$	2,751.00
Jun-2017	$	3,021.00
Mar-2017	$	2,403.00
May-2017	$	2,847.00
Nov-2017	$	2,274.00
Oct-2017	$	2,373.00
Sep-2017	$	2,493.00
[redacted]		
Apr-2017	$	73.43
Aug-2017	$	73.43
Dec-2017	$	73.43
Jan-2017	$	73.43
Jul-2017	$	220.29
Jun-2017	$	220.29
Mar-2017	$	73.43
Nov-2017	$	73.43
Oct-2017	$	146.86
Sep-2017	$	73.43
[redacted]		
Apr-2017	$	3,684.00
Aug-2017	$	4,024.00
Dec-2017	$	2,584.00
Feb-2017	$	2,004.00
Jan-2017	$	2,012.00
Jul-2017	$	3,868.00
Jun-2017	$	3,908.00
Mar-2017	$	3,168.00
May-2017	$	3,556.00
Nov-2017	$	3,156.00
Oct-2017	$	3,444.00
Sep-2017	$	3,456.00
[redacted]		
Apr-2017	$	1,660.14
Aug-2017	$	1,660.14
Dec-2017	$	922.30
Feb-2017	$	737.84
Jan-2017	$	922.30
Jul-2017	$	1,475.68
Jun-2017	$	1,660.14
Mar-2017	$	1,106.76
May-2017	$	1,475.68
Nov-2017	$	1,475.68
Oct-2017	$	1,475.68
Sep-2017	$	1,475.68
[redacted]		
Apr-2017	$	352.17
Aug-2017	$	352.17
Dec-2017	$	234.78
Feb-2017	$	704.34
Jul-2017	$	469.56
Jun-2017	$	352.17
Mar-2017	$	234.78
May-2017	$	469.56
Nov-2017	$	352.17
Oct-2017	$	234.78
Sep-2017	$	469.56
[redacted]		
Apr-2017	$	469.56
Aug-2017	$	352.17

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Duke Energy Progress, LLC
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Counterparty and Payment Dates		REC Cost
Dec-2017	$	352.17
Feb-2017	$	117.39
Jan-2017	$	234.78
Jul-2017	$	469.56
Jun-2017	$	352.17
Mar-2017	$	117.39
May-2017	$	352.17
Nov-2017	$	234.78
Oct-2017	$	352.17
Sep-2017	$	352.17
[redacted]		
Apr-2017	$	-
Aug-2017	$	8,775.44
Dec-2017	$	-
Feb-2017	$	-
Jan-2017	$	-
Jul-2017	$	10,051.08
Jun-2017	$	-
Mar-2017	$	-
May-2017	$	-
Nov-2017	$	-
Oct-2017	$	1,776.09
Sep-2017	$	17,350.80
[redacted]		
Apr-2017	$	3,965.22
Aug-2017	$	4,846.38
Dec-2017	$	2,643.48
Feb-2017	$	1,395.17
Jan-2017	$	2,349.76
Jul-2017	$	5,727.54
Jun-2017	$	4,405.80
Mar-2017	$	2,276.33
May-2017	$	4,332.37
Nov-2017	$	3,524.64
Oct-2017	$	4,479.23
Sep-2017	$	4,772.95
[redacted]		
Apr-2017	$	13,696.50
Aug-2017	$	14,679.75
Dec-2017	$	11,195.25
Feb-2017	$	7,848.75
Jan-2017	$	8,607.75
Jul-2017	$	16,008.00
Jun-2017	$	16,318.50
Mar-2017	$	13,403.25
May-2017	$	15,162.75
Nov-2017	$	13,679.25
Oct-2017	$	14,507.25
Sep-2017	$	11,074.50
[redacted]		
Apr-2017	$	3,732.00
Aug-2017	$	4,096.00
Dec-2017	$	2,724.00
Feb-2017	$	2,048.00
Jan-2017	$	2,052.00
Jul-2017	$	4,000.00
Jun-2017	$	4,024.00
Mar-2017	$	3,280.00
May-2017	$	3,880.00
Nov-2017	$	3,256.00
Oct-2017	$	3,416.00

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June 20, 2018

Counterparty and Payment Dates		REC Cost
Sep-2017	$	3,728.00
[redacted]		
Apr-2017	$	98,720.58
Aug-2017	$	110,941.46
Dec-2017	$	123,726.68
Feb-2017	$	101,853.64
Jan-2017	$	117,817.44
Jul-2017	$	102,262.30
Jun-2017	$	73,325.28
Mar-2017	$	86,811.06
May-2017	$	94,419.92
Nov-2017	$	133,476.14
Oct-2017	$	126,704.06
Sep-2017	$	114,638.86
[redacted]		
Apr-2017	$	4,705.00
Aug-2017	$	5,080.00
Dec-2017	$	3,700.00
Feb-2017	$	3,060.00
Jan-2017	$	2,855.00
Jul-2017	$	4,570.00
Jun-2017	$	5,055.00
Mar-2017	$	4,105.00
May-2017	$	4,630.00
Nov-2017	$	4,180.00
Oct-2017	$	4,585.00
Sep-2017	$	4,440.00
[redacted]		
Apr-2017	$	3,636.00
Aug-2017	$	3,964.00
Dec-2017	$	2,808.00
Feb-2017	$	2,168.00
Jan-2017	$	2,168.00
Jul-2017	$	3,608.00
Jun-2017	$	3,936.00
Mar-2017	$	3,348.00
May-2017	$	3,824.00
Nov-2017	$	3,284.00
Oct-2017	$	3,376.00
Sep-2017	$	3,576.00
[redacted]		
Apr-2017	$	3,704.00
Aug-2017	$	4,136.00
Dec-2017	$	2,176.00
Feb-2017	$	1,476.00
Jan-2017	$	1,552.00
Jul-2017	$	4,048.00
Jun-2017	$	3,700.00
Mar-2017	$	2,768.00
May-2017	$	3,564.00
Nov-2017	$	3,032.00
Oct-2017	$	3,352.00
Sep-2017	$	3,588.00
[redacted]		
Apr-2017	$	4,570.00
Aug-2017	$	4,800.00
Dec-2017	$	3,560.00
Feb-2017	$	3,000.00
Jan-2017	$	2,690.00
Jul-2017	$	4,400.00
Jun-2017	$	4,900.00

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Mar-2017	$	3,965.00
May-2017	$	4,580.00
Nov-2017	$	3,860.00
Oct-2017	$	4,250.00
Sep-2017	$	3,945.00
[redacted]		
Apr-2017	$	73.43
Aug-2017	$	146.86
Dec-2017	$	73.43
Feb-2017	$	73.43
Jan-2017	$	73.43
Jul-2017	$	146.86
Jun-2017	$	73.43
Mar-2017	$	73.43
May-2017	$	146.86
Nov-2017	$	73.43
Oct-2017	$	73.43
Sep-2017	$	146.86
[redacted]		
Apr-2017	$	4,859.71
Aug-2017	$	9,940.92
Dec-2017	$	3,632.60
Feb-2017	$	4,558.58
Jan-2017	$	2,656.83
Jun-2017	$	9,830.17
Mar-2017	$	3,960.42
Nov-2017	$	9,839.03
Sep-2017	$	4,576.19
[redacted]		
Apr-2017	$	3,532.00
Aug-2017	$	3,932.00
Dec-2017	$	2,636.00
Feb-2017	$	1,956.00
Jan-2017	$	1,972.00
Jul-2017	$	3,796.00
Jun-2017	$	3,860.00
Mar-2017	$	3,168.00
May-2017	$	3,564.00
Nov-2017	$	3,056.00
Oct-2017	$	2,904.00
Sep-2017	$	2,452.00
[redacted]		
Apr-2017	$	3,991.26
Aug-2017	$	4,226.04
Dec-2017	$	2,934.75
Feb-2017	$	1,995.63
Jan-2017	$	2,230.41
Jul-2017	$	4,108.65
Jun-2017	$	3,991.26
Mar-2017	$	3,169.53
May-2017	$	3,873.87
Nov-2017	$	3,521.70
Oct-2017	$	3,756.48
Sep-2017	$	3,873.87
[redacted]		
Apr-2017	$	17,688.88
Aug-2017	$	19,296.96
Dec-2017	$	11,658.58
Feb-2017	$	8,040.40
Jan-2017	$	9,792.00
Jul-2017	$	18,894.94

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Counterparty and Payment Dates		REC Cost
Jun-2017	$	17,487.87
Mar-2017	$	13,668.68
May-2017	$	16,884.84
Nov-2017	$	14,874.74
Oct-2017	$	15,678.78
Sep-2017	$	17,085.85
[redacted]		
Apr-2017	$	2,582.58
Aug-2017	$	4,108.65
Dec-2017	$	2,934.75
Feb-2017	$	1,995.63
Jan-2017	$	3,052.14
Jul-2017	$	3,756.48
Jun-2017	$	3,286.92
Mar-2017	$	1,526.07
May-2017	$	3,873.87
Nov-2017	$	3,404.31
Oct-2017	$	3,404.31
Sep-2017	$	3,404.31
[redacted]		
Apr-2017	$	760.50
Aug-2017	$	884.25
Dec-2017	$	571.50
Feb-2017	$	468.00
Jan-2017	$	659.25
Jul-2017	$	875.25
Jun-2017	$	798.75
Mar-2017	$	414.00
May-2017	$	785.25
Nov-2017	$	749.25
Oct-2017	$	855.00
Sep-2017	$	832.50
[redacted]		
Apr-2017	$	3,800.00
Aug-2017	$	3,896.00
Dec-2017	$	2,964.00
Feb-2017	$	2,372.00
Jan-2017	$	2,232.00
Jul-2017	$	3,600.00
Jun-2017	$	4,100.00
Mar-2017	$	3,348.00
May-2017	$	3,792.00
Nov-2017	$	3,328.00
Oct-2017	$	3,652.00
Sep-2017	$	3,372.00
[redacted]		
Apr-2017	$	7,556.82
Aug-2017	$	6,905.37
Dec-2017	$	5,602.47
Feb-2017	$	3,430.97
Jan-2017	$	5,428.75
Jul-2017	$	7,904.26
Jun-2017	$	6,644.79
Mar-2017	$	4,299.57
May-2017	$	6,471.07
Nov-2017	$	6,253.92
Oct-2017	$	7,556.82
Sep-2017	$	5,863.05
[redacted]		
Apr-2017	$	3,588.00
Aug-2017	$	3,948.00

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Dec-2017	$	2,792.00
Feb-2017	$	2,260.00
Jan-2017	$	2,164.00
Jul-2017	$	3,616.00
Jun-2017	$	3,960.00
Mar-2017	$	3,252.00
May-2017	$	3,760.00
Nov-2017	$	3,196.00
Oct-2017	$	3,320.00
Sep-2017	$	3,380.00
[redacted]		
Apr-2017	$	1,964.25
Aug-2017	$	2,031.75
Dec-2017	$	1,611.00
Feb-2017	$	1,023.75
Jan-2017	$	1,228.50
Jul-2017	$	1,840.50
Jun-2017	$	2,088.00
Mar-2017	$	1,602.00
May-2017	$	2,011.50
Nov-2017	$	1,732.50
Oct-2017	$	1,815.75
Sep-2017	$	1,734.75
[redacted]		
Apr-2017	$	4,560.00
Aug-2017	$	4,960.00
Dec-2017	$	3,185.00
Feb-2017	$	2,345.00
Jan-2017	$	2,495.00
Jul-2017	$	4,730.00
Jun-2017	$	4,715.00
Mar-2017	$	3,875.00
May-2017	$	4,610.00
Nov-2017	$	3,930.00
Oct-2017	$	3,920.00
Sep-2017	$	4,375.00
[redacted]		
Apr-2017	$	4,025.00
Aug-2017	$	4,805.00
Dec-2017	$	3,005.00
Feb-2017	$	2,285.00
Jan-2017	$	2,605.00
Jul-2017	$	4,620.00
Jun-2017	$	4,430.00
Mar-2017	$	3,645.00
May-2017	$	4,310.00
Nov-2017	$	3,885.00
Oct-2017	$	3,955.00
Sep-2017	$	4,300.00
[redacted]		
Apr-2017	$	352.17
Aug-2017	$	469.56
Dec-2017	$	234.78
Feb-2017	$	117.39
Jan-2017	$	352.17
Jul-2017	$	469.56
Jun-2017	$	469.56
Mar-2017	$	234.78
May-2017	$	469.56
Nov-2017	$	352.17
Oct-2017	$	469.56

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Counterparty and Payment Dates		REC Cost
Sep-2017	$	469.56
[redacted]		
Apr-2017	$	2,850.00
Aug-2017	$	3,150.00
Dec-2017	$	2,064.00
Feb-2017	$	1,533.00
Jan-2017	$	1,470.00
Jul-2017	$	3,015.00
Jun-2017	$	3,060.00
Mar-2017	$	2,481.00
May-2017	$	2,853.00
Nov-2017	$	2,193.00
Oct-2017	$	2,712.00
Sep-2017	$	2,859.00
[redacted]		
Apr-2017	$	3,756.00
Aug-2017	$	4,064.00
Dec-2017	$	2,672.00
Feb-2017	$	1,580.00
Jul-2017	$	4,024.00
Jun-2017	$	3,716.00
Mar-2017	$	2,972.00
May-2017	$	3,604.00
Nov-2017	$	3,228.00
Oct-2017	$	3,492.00
Sep-2017	$	3,632.00
[redacted]		
Apr-2017	$	209,359.75
Aug-2017	$	188,967.25
Dec-2017	$	256,766.00
Feb-2017	$	239,525.25
Jan-2017	$	235,301.25
Jul-2017	$	219,203.50
Jun-2017	$	220,305.50
Mar-2017	$	262,293.00
May-2017	$	181,615.00
Nov-2017	$	273,839.50
Oct-2017	$	212,140.25
Sep-2017	$	232,805.75
[redacted]		
Apr-2017	$	263,296.00
Aug-2017	$	310,963.75
Dec-2017	$	353,140.00
Feb-2017	$	222,928.75
Jan-2017	$	307,371.00
Jul-2017	$	250,238.00
Jun-2017	$	243,932.25
Mar-2017	$	324,998.50
May-2017	$	239,045.25
Nov-2017	$	406,084.00
Oct-2017	$	301,532.75
Sep-2017	$	333,997.75
[redacted]		
Apr-2017	$	711,511.68
Aug-2017	$	909,739.68
Dec-2017	$	620,970.24
Feb-2017	$	675,301.52
Jan-2017	$	655,750.42
Jul-2017	$	662,449.92
Jun-2017	$	813,396.16
Mar-2017	$	631,973.76

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May-2017	$	895,086.80
Nov-2017	$	888,532.64
Oct-2017	$	600,209.28
Sep-2017	$	735,804.24
[redacted]		
Apr-2017	$	3,740.00
Aug-2017	$	3,984.00
Dec-2017	$	2,396.00
Feb-2017	$	1,468.00
Jan-2017	$	1,416.00
Jul-2017	$	3,908.00
Jun-2017	$	3,708.00
Mar-2017	$	2,836.00
May-2017	$	3,632.00
Nov-2017	$	3,104.00
Oct-2017	$	3,424.00
Sep-2017	$	3,564.00
[redacted]		
Apr-2017	$	4,065.00
Aug-2017	$	4,945.00
Dec-2017	$	3,320.00
Feb-2017	$	2,475.00
Jan-2017	$	2,315.00
Jul-2017	$	2,265.00
Jun-2017	$	4,560.00
Mar-2017	$	3,555.00
May-2017	$	4,445.00
Nov-2017	$	3,955.00
Oct-2017	$	4,120.00
Sep-2017	$	4,295.00
[redacted]		
Apr-2017	$	2,760.00
Aug-2017	$	3,087.00
Dec-2017	$	1,911.00
Feb-2017	$	1,038.00
Jan-2017	$	1,533.00
Jul-2017	$	2,955.00
Jun-2017	$	2,745.00
Mar-2017	$	2,148.00
May-2017	$	2,655.00
Nov-2017	$	2,247.00
Oct-2017	$	2,493.00
Sep-2017	$	2,607.00
[redacted]		
Apr-2017	$	2,172.03
Aug-2017	$	2,896.04
Dec-2017	$	1,965.17
Feb-2017	$	1,344.59
Jan-2017	$	1,758.31
Jul-2017	$	2,896.04
Jun-2017	$	2,482.32
Mar-2017	$	1,137.73
May-2017	$	2,275.46
Nov-2017	$	2,275.46
Oct-2017	$	2,689.18
Sep-2017	$	2,585.75
[redacted]		
Apr-2017	$	335.00
Aug-2017	$	85.00
Dec-2017	$	110.00
Feb-2017	$	555.00

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Jul-2017	$	605.00
Jun-2017	$	610.00
Mar-2017	$	300.00
May-2017	$	610.00
Nov-2017	$	130.00
Oct-2017	$	120.00
Sep-2017	$	105.00
[redacted]		
Apr-2017	$	900.00
Aug-2017	$	1,200.00
Dec-2017	$	600.00
Feb-2017	$	300.00
Jan-2017	$	450.00
Jul-2017	$	1,200.00
Jun-2017	$	1,050.00
Mar-2017	$	750.00
May-2017	$	1,050.00
Nov-2017	$	900.00
Oct-2017	$	900.00
Sep-2017	$	900.00
[redacted]		
Apr-2017	$	3,375.00
Aug-2017	$	4,660.00
Dec-2017	$	3,570.00
Feb-2017	$	2,840.00
Jan-2017	$	2,745.00
Jul-2017	$	4,255.00
Jun-2017	$	4,800.00
Mar-2017	$	3,215.00
May-2017	$	4,520.00
Nov-2017	$	3,505.00
Oct-2017	$	3,690.00
Sep-2017	$	3,860.00
[redacted]		
Apr-2017	$	234.78
Aug-2017	$	234.78
Dec-2017	$	117.39
Jan-2017	$	234.78
Jul-2017	$	469.56
Jun-2017	$	234.78
Mar-2017	$	234.78
May-2017	$	234.78
Nov-2017	$	234.78
Oct-2017	$	352.17
Sep-2017	$	352.17
[redacted]		
Apr-2017	$	4,095.00
Aug-2017	$	4,360.00
Dec-2017	$	3,400.00
Feb-2017	$	2,795.00
Jan-2017	$	2,570.00
Jul-2017	$	4,225.00
Jun-2017	$	4,635.00
Mar-2017	$	3,620.00
May-2017	$	4,410.00
Nov-2017	$	3,725.00
Oct-2017	$	3,735.00
Sep-2017	$	3,895.00
[redacted]		
Apr-2017	$	1,964.25
Aug-2017	$	2,124.00

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Dec-2017	$	1,599.75
Feb-2017	$	1,253.25
Jan-2017	$	1,206.00
Jul-2017	$	1,930.50
Jun-2017	$	2,085.75
Mar-2017	$	1,777.50
May-2017	$	1,998.00
Nov-2017	$	1,779.75
Oct-2017	$	1,759.50
Sep-2017	$	1,806.75
[redacted]		
Apr-2017	$	834.75
Aug-2017	$	884.25
Dec-2017	$	634.50
Feb-2017	$	461.25
Jan-2017	$	573.75
Jul-2017	$	848.25
Jun-2017	$	717.75
Mar-2017	$	690.75
May-2017	$	904.50
Nov-2017	$	641.25
Oct-2017	$	753.75
Sep-2017	$	717.75
[redacted]		
Aug-2017	$	352.17
Feb-2017	$	234.78
Jul-2017	$	117.39
Jun-2017	$	234.78
Mar-2017	$	117.39
May-2017	$	117.39
Nov-2017	$	352.17
Oct-2017	$	117.39
[redacted]		
Apr-2017	$	4,545.00
Aug-2017	$	4,775.00
Dec-2017	$	3,625.00
Feb-2017	$	3,050.00
Jan-2017	$	2,685.00
Jul-2017	$	4,285.00
Jun-2017	$	4,780.00
Mar-2017	$	4,035.00
May-2017	$	4,440.00
Nov-2017	$	4,170.00
Oct-2017	$	4,480.00
Sep-2017	$	4,200.00
[redacted]		
Apr-2017	$	-
Aug-2017	$	-
Dec-2017	$	-
Feb-2017	$	-
Jan-2017	$	-
Jul-2017	$	-
Jun-2017	$	-
Mar-2017	$	-
May-2017	$	-
Nov-2017	$	-
Oct-2017	$	-
Sep-2017	$	-
[redacted]		
Apr-2017	$	3,748.00
Aug-2017	$	4,136.00

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Dec-2017	$	2,736.00
Feb-2017	$	2,112.00
Jan-2017	$	2,140.00
Jul-2017	$	3,840.00
Jun-2017	$	3,988.00
Mar-2017	$	3,284.00
May-2017	$	3,648.00
Nov-2017	$	3,228.00
Oct-2017	$	3,532.00
Sep-2017	$	3,540.00
[redacted]		
Apr-2017	$	3,645.00
Aug-2017	$	4,000.00
Dec-2017	$	2,635.00
Feb-2017	$	2,040.00
Jan-2017	$	2,020.00
Jul-2017	$	3,720.00
Jun-2017	$	3,865.00
Mar-2017	$	3,155.00
May-2017	$	3,610.00
Nov-2017	$	3,040.00
Oct-2017	$	3,395.00
Sep-2017	$	3,535.00
[redacted]		
Apr-2017	$	4,400.00
Aug-2017	$	4,740.00
Dec-2017	$	3,300.00
Feb-2017	$	2,515.00
Jan-2017	$	2,435.00
Jul-2017	$	4,225.00
Jun-2017	$	4,600.00
Mar-2017	$	3,980.00
May-2017	$	4,470.00
Nov-2017	$	3,845.00
Oct-2017	$	4,040.00
Sep-2017	$	4,035.00
[redacted]		
Apr-2017	$	3,230.92
Aug-2017	$	4,112.08
Dec-2017	$	3,451.21
Feb-2017	$	2,349.76
Jan-2017	$	3,451.21
Jul-2017	$	4,552.66
Jun-2017	$	4,258.94
Mar-2017	$	1,982.61
May-2017	$	4,772.95
Nov-2017	$	4,258.94
Oct-2017	$	3,818.36
Sep-2017	$	5,066.67
[redacted]		
Apr-2017	$	1,172.00
Aug-2017	$	1,416.00
Dec-2017	$	1,172.00
Feb-2017	$	792.00
Jan-2017	$	1,068.00
Jul-2017	$	1,272.00
Jun-2017	$	1,292.00
Mar-2017	$	808.00
May-2017	$	1,444.00
Nov-2017	$	1,152.00
Oct-2017	$	1,392.00

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Counterparty and Payment Dates		REC Cost
Sep-2017	$	1,288.00
[redacted]		
Apr-2017	$	4,425.00
Aug-2017	$	4,660.00
Dec-2017	$	3,420.00
Feb-2017	$	2,565.00
Jan-2017	$	2,600.00
Jul-2017	$	3,915.00
Jun-2017	$	4,710.00
Mar-2017	$	4,030.00
May-2017	$	4,515.00
Nov-2017	$	3,675.00
Oct-2017	$	2,685.00
Sep-2017	$	4,435.00
[redacted]		
Aug-2017	$	33,599.55
Dec-2017	$	9,544.22
Feb-2017	$	7,926.94
Jan-2017	$	7,535.81
Jun-2017	$	31,749.14
Mar-2017	$	12,271.14
May-2017	$	14,413.72
Nov-2017	$	26,295.30
Sep-2017	$	12,952.87
[redacted]		
Apr-2017	$	234.78
Aug-2017	$	469.56
Dec-2017	$	234.78
Feb-2017	$	117.39
Jan-2017	$	234.78
Jul-2017	$	586.95
Jun-2017	$	352.17
Mar-2017	$	234.78
May-2017	$	469.56
Nov-2017	$	352.17
Oct-2017	$	352.17
Sep-2017	$	352.17
[redacted]		
Apr-2017	$	5,081.36
Aug-2017	$	5,449.09
Dec-2017	$	3,376.43
Feb-2017	$	2,279.81
Jan-2017	$	3,708.74
Jul-2017	$	5,549.38
Jun-2017	$	3,844.45
Mar-2017	$	3,510.15
May-2017	$	5,950.54
Nov-2017	$	4,212.18
Oct-2017	$	4,412.76
Sep-2017	$	5,215.08
[redacted]		
Apr-2017	$	7,982.52
Aug-2017	$	9,273.81
Dec-2017	$	6,573.84
Feb-2017	$	3,169.53
Jan-2017	$	3,873.87
Jul-2017	$	8,569.47
Jun-2017	$	9,039.03
Mar-2017	$	4,695.60
May-2017	$	8,217.30
Nov-2017	$	8,217.30

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Counterparty and Payment Dates		REC Cost
Oct-2017	$	7,747.74
Sep-2017	$	8,217.30
[redacted]		
Apr-2017	$	1,356.75
Aug-2017	$	1,683.00
Dec-2017	$	1,192.50
Feb-2017	$	976.50
Jan-2017	$	882.00
Jul-2017	$	1,471.50
Jun-2017	$	1,651.50
Mar-2017	$	1,320.75
May-2017	$	1,543.50
Nov-2017	$	1,318.50
Oct-2017	$	1,496.25
Sep-2017	$	1,408.50
[redacted]		
Apr-2017	$	607.50
Aug-2017	$	767.25
Dec-2017	$	571.50
Feb-2017	$	393.75
Jan-2017	$	564.75
Jul-2017	$	704.25
Jun-2017	$	684.00
Mar-2017	$	452.25
May-2017	$	749.25
Nov-2017	$	697.50
Oct-2017	$	621.00
Sep-2017	$	697.50
[redacted]		
Apr-2017	$	890.00
Aug-2017	$	1,830.00
Dec-2017	$	1,305.00
Feb-2017	$	895.00
Jan-2017	$	1,190.00
Jul-2017	$	1,965.00
Jun-2017	$	1,625.00
Mar-2017	$	645.00
May-2017	$	1,255.00
Nov-2017	$	1,470.00
Oct-2017	$	1,800.00
Sep-2017	$	1,565.00
[redacted]		
Apr-2017	$	1,034.30
Aug-2017	$	1,551.45
Dec-2017	$	827.44
Feb-2017	$	517.15
Jan-2017	$	827.44
Jul-2017	$	2,689.18
Jun-2017	$	1,241.16
Mar-2017	$	724.01
Nov-2017	$	1,137.73
Oct-2017	$	1,137.73
Sep-2017	$	1,344.59
[redacted]		
Apr-2017	$	2,836.62
Aug-2017	$	2,669.76
Dec-2017	$	1,918.89
Feb-2017	$	1,168.02
Jan-2017	$	2,002.32
Jul-2017	$	3,003.48
Jun-2017	$	3,086.91

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Mar-2017	$	1,668.60
May-2017	$	3,003.48
Nov-2017	$	2,169.18
Oct-2017	$	2,753.19
Sep-2017	$	2,920.05
[redacted]		
Apr-2017	$	25.00
Feb-2017	$	17.50
Jan-2017	$	22.50
Mar-2017	$	12.50
[redacted]		
Apr-2017	$	3,260.00
Aug-2017	$	3,550.00
Dec-2017	$	2,440.00
Feb-2017	$	2,040.00
Jan-2017	$	1,855.00
Jul-2017	$	3,010.00
Jun-2017	$	3,490.00
Mar-2017	$	2,775.00
May-2017	$	3,290.00
Nov-2017	$	2,485.00
Oct-2017	$	3,005.00
Sep-2017	$	3,025.00
[redacted]		
Apr-2017	$	4,210.00
Aug-2017	$	4,635.00
Dec-2017	$	3,245.00
Feb-2017	$	2,665.00
Jan-2017	$	2,470.00
Jul-2017	$	4,300.00
Jun-2017	$	4,625.00
Mar-2017	$	3,760.00
May-2017	$	4,415.00
Nov-2017	$	3,760.00
Oct-2017	$	3,710.00
Sep-2017	$	3,920.00
[redacted]		
Apr-2017	$	4,565.00
Aug-2017	$	4,970.00
Dec-2017	$	3,505.00
Feb-2017	$	2,995.00
Jan-2017	$	2,705.00
Jul-2017	$	4,200.00
Jun-2017	$	4,965.00
Mar-2017	$	4,020.00
May-2017	$	4,625.00
Nov-2017	$	3,900.00
Oct-2017	$	4,365.00
Sep-2017	$	4,285.00
[redacted]		
Apr-2017	$	586.95
Aug-2017	$	939.12
Dec-2017	$	469.56
Feb-2017	$	352.17
Jan-2017	$	469.56
Jul-2017	$	939.12
Jun-2017	$	821.73
Mar-2017	$	469.56
May-2017	$	821.73
Nov-2017	$	704.34
Oct-2017	$	821.73

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Sep-2017	$	821.73
[redacted]		
Apr-2017	$	4,685.00
Aug-2017	$	5,135.00
Dec-2017	$	3,585.00
Feb-2017	$	2,840.00
Jan-2017	$	2,675.00
Jul-2017	$	4,760.00
Jun-2017	$	5,055.00
Mar-2017	$	4,070.00
May-2017	$	4,555.00
Nov-2017	$	4,220.00
Oct-2017	$	4,505.00
Sep-2017	$	4,485.00
[redacted]		
Apr-2017	$	688.50
Aug-2017	$	1,876.50
Feb-2017	$	857.25
Jul-2017	$	753.75
Jun-2017	$	823.50
May-2017	$	886.50
Nov-2017	$	1,354.50
Oct-2017	$	918.00
[redacted]		
Apr-2017	$	4,485.00
Aug-2017	$	5,205.00
Dec-2017	$	3,635.00
Feb-2017	$	2,845.00
Jan-2017	$	2,710.00
Jul-2017	$	4,490.00
Jun-2017	$	5,030.00
Mar-2017	$	4,095.00
May-2017	$	4,155.00
Nov-2017	$	4,090.00
Oct-2017	$	4,650.00
Sep-2017	$	4,665.00
[redacted]		
Apr-2017	$	4,675.00
Aug-2017	$	5,260.00
Dec-2017	$	3,450.00
Feb-2017	$	2,565.00
Jan-2017	$	2,725.00
Jul-2017	$	5,080.00
Jun-2017	$	4,815.00
Mar-2017	$	4,045.00
May-2017	$	4,890.00
Nov-2017	$	4,185.00
Oct-2017	$	4,240.00
Sep-2017	$	4,715.00
[redacted]		
Apr-2017	$	4,585.00
Aug-2017	$	5,340.00
Dec-2017	$	3,470.00
Feb-2017	$	2,965.00
Jan-2017	$	2,715.00
Jul-2017	$	4,825.00
Jun-2017	$	5,110.00
Mar-2017	$	4,060.00
May-2017	$	4,655.00
Nov-2017	$	4,165.00
Oct-2017	$	4,665.00

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Counterparty and Payment Dates		REC Cost
Sep-2017	$	4,650.00
[redacted]		
Apr-2017	$	3,716.00
Aug-2017	$	4,032.00
Dec-2017	$	2,476.00
Feb-2017	$	1,840.00
Jan-2017	$	1,920.00
Jul-2017	$	3,572.00
Jun-2017	$	3,720.00
Mar-2017	$	3,088.00
May-2017	$	3,512.00
Nov-2017	$	2,968.00
Oct-2017	$	3,444.00
Sep-2017	$	3,464.00
[redacted]		
Apr-2017	$	4,335.00
Aug-2017	$	4,725.00
Dec-2017	$	2,960.00
Feb-2017	$	2,145.00
Jan-2017	$	2,270.00
Jul-2017	$	4,500.00
Jun-2017	$	4,675.00
Mar-2017	$	3,635.00
May-2017	$	4,465.00
Nov-2017	$	3,700.00
Oct-2017	$	3,785.00
Sep-2017	$	4,070.00
[redacted]		
Aug-2017	$	3,360.00
Jul-2017	$	1,596.00
Jun-2017	$	1,552.00
Mar-2017	$	2,076.00
May-2017	$	2,288.00
Nov-2017	$	2,920.00
Oct-2017	$	1,416.00
[redacted]		
Apr-2017	$	5,165.16
Aug-2017	$	2,465.19
Dec-2017	$	4,460.82
Feb-2017	$	2,582.58
Jan-2017	$	4,108.65
Jul-2017	$	6,691.23
Jun-2017	$	7,865.13
Mar-2017	$	3,286.92
May-2017	$	6,456.45
Nov-2017	$	5,986.89
Oct-2017	$	6,339.06
Sep-2017	$	7,043.40
[redacted]		
Apr-2017	$	9,947.34
Aug-2017	$	16,510.23
Dec-2017	$	10,035.63
Feb-2017	$	6,281.47
Jan-2017	$	8,448.44
Jul-2017	$	12,448.89
Jun-2017	$	14,273.55
Mar-2017	$	5,738.85
May-2017	$	15,303.60
Nov-2017	$	11,183.40
Oct-2017	$	11,654.28
Sep-2017	$	10,182.78

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Counterparty and Payment Dates		REC Cost
[redacted]		
Apr-2017	$	3,404.31
Aug-2017	$	3,639.09
Dec-2017	$	2,347.80
Feb-2017	$	1,643.46
Jan-2017	$	2,230.41
Jul-2017	$	3,991.26
Jun-2017	$	3,639.09
Mar-2017	$	2,347.80
May-2017	$	3,756.48
Nov-2017	$	2,817.36
Oct-2017	$	3,756.48
Sep-2017	$	3,169.53
[redacted]		
Apr-2017	$	3,052.14
Aug-2017	$	3,873.87
Dec-2017	$	1,526.07
Feb-2017	$	1,408.68
Jan-2017	$	2,465.19
Jul-2017	$	3,756.48
Jun-2017	$	2,817.36
Mar-2017	$	1,526.07
May-2017	$	2,347.80
Nov-2017	$	1,995.63
Oct-2017	$	2,113.02
Sep-2017	$	2,699.97
[redacted]		
Apr-2017	$	2,912.00
Aug-2017	$	2,916.00
Dec-2017	$	2,172.00
Feb-2017	$	1,692.00
Jan-2017	$	1,692.00
Jul-2017	$	3,036.00
Jun-2017	$	3,088.00
Mar-2017	$	2,572.00
May-2017	$	2,964.00
Nov-2017	$	2,480.00
Oct-2017	$	2,744.00
Sep-2017	$	2,808.00
[redacted]		
Apr-2017	$	2,691.00
Aug-2017	$	2,898.00
Dec-2017	$	2,031.00
Feb-2017	$	1,707.00
Jan-2017	$	1,656.00
Jul-2017	$	2,649.00
Jun-2017	$	2,892.00
Mar-2017	$	2,433.00
May-2017	$	2,769.00
Nov-2017	$	2,433.00
Oct-2017	$	2,406.00
Sep-2017	$	2,520.00
[redacted]		
Apr-2017	$	1,388.00
Aug-2017	$	1,544.00
Dec-2017	$	1,184.00
Feb-2017	$	684.00
Jan-2017	$	1,020.00
Jul-2017	$	1,684.00
Jun-2017	$	1,204.00
Mar-2017	$	1,084.00

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May-2017	$	1,644.00
Nov-2017	$	1,204.00
Oct-2017	$	1,440.00
Sep-2017	$	1,332.00
[redacted]		
Apr-2017	$	1,173.90
Aug-2017	$	1,995.63
Dec-2017	$	939.12
Feb-2017	$	469.56
Jan-2017	$	939.12
Jul-2017	$	1,995.63
Jun-2017	$	1,291.29
Mar-2017	$	821.73
May-2017	$	1,760.85
Nov-2017	$	2,934.75
Sep-2017	$	1,878.24
[redacted]		
Apr-2017	$	1,101.45
Aug-2017	$	1,762.32
Dec-2017	$	807.73
Feb-2017	$	514.01
Jan-2017	$	734.30
Jul-2017	$	1,688.89
Jun-2017	$	1,101.45
Mar-2017	$	660.87
May-2017	$	1,615.46
Nov-2017	$	2,423.19
Sep-2017	$	1,615.46
[redacted]		
Apr-2017	$	3,656.00
Aug-2017	$	4,264.00
Dec-2017	$	2,464.00
Feb-2017	$	2,332.00
Jan-2017	$	2,068.00
Jul-2017	$	3,764.00
Jun-2017	$	4,048.00
Mar-2017	$	3,132.00
May-2017	$	3,644.00
Nov-2017	$	3,344.00
Oct-2017	$	3,736.00
Sep-2017	$	3,492.00
[redacted]		
Apr-2017	$	3,572.00
Aug-2017	$	3,944.00
Dec-2017	$	2,768.00
Feb-2017	$	2,132.00
Jan-2017	$	1,132.00
Jul-2017	$	3,700.00
Jun-2017	$	3,776.00
Mar-2017	$	3,288.00
May-2017	$	3,740.00
Nov-2017	$	3,268.00
Oct-2017	$	3,332.00
Sep-2017	$	3,416.00
[redacted]		
Apr-2017	$	2,748.00
Aug-2017	$	3,120.00
Dec-2017	$	1,191.00
Feb-2017	$	1,653.00
Jan-2017	$	1,581.00
Jul-2017	$	2,919.00

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Counterparty and Payment Dates		REC Cost
Jun-2017	$	3,021.00
Mar-2017	$	2,553.00
May-2017	$	2,793.00
Nov-2017	$	2,529.00
Oct-2017	$	2,562.00
Sep-2017	$	2,796.00
[redacted]		
Apr-2017	$	-
Aug-2017	$	-
Dec-2017	$	-
Feb-2017	$	-
Jan-2017	$	-
Jul-2017	$	-
Jun-2017	$	-
Mar-2017	$	-
May-2017	$	-
Nov-2017	$	-
Oct-2017	$	-
Sep-2017	$	-
[redacted]		
Apr-2017	$	2,585.75
Aug-2017	$	3,206.33
Dec-2017	$	1,758.31
Feb-2017	$	1,034.30
Jan-2017	$	1,448.02
Jul-2017	$	2,999.47
Jun-2017	$	5,688.65
Mar-2017	$	1,758.31
Nov-2017	$	1,965.17
Oct-2017	$	2,482.32
Sep-2017	$	3,102.90
[redacted]		
Apr-2017	$	21,043.75
Aug-2017	$	21,737.50
Dec-2017	$	15,793.75
Feb-2017	$	19,905.17
Jan-2017	$	19,441.44
Jul-2017	$	23,081.25
Jun-2017	$	21,931.25
Mar-2017	$	23,512.50
May-2017	$	22,587.50
Nov-2017	$	18,125.00
Oct-2017	$	19,500.00
Sep-2017	$	21,387.50
[redacted]		
Apr-2017	$	960.00
Aug-2017	$	1,076.00
Dec-2017	$	752.00
Feb-2017	$	544.00
Jan-2017	$	736.00
Jun-2017	$	1,052.00
Mar-2017	$	664.00
May-2017	$	1,036.00
Nov-2017	$	1,676.00
Sep-2017	$	1,868.00
[redacted]		
Aug-2017	$	66,964.00
Dec-2017	$	44,412.00
Jul-2017	$	19,864.00
Nov-2017	$	109,724.00
Oct-2017	$	56,988.00

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[redacted]		
Apr-2017	$	68,220.00
Aug-2017	$	30,080.00
Dec-2017	$	21,556.00
Jul-2017	$	25,664.00
Jun-2017	$	30,184.00
May-2017	$	28,508.00
Nov-2017	$	24,020.00
Oct-2017	$	24,716.00
Sep-2017	$	23,996.00
[redacted]		
Apr-2017	$	3,572.00
Aug-2017	$	3,600.00
Dec-2017	$	2,656.00
Feb-2017	$	2,200.00
Jan-2017	$	1,960.00
Jul-2017	$	3,352.00
Jun-2017	$	3,800.00
Mar-2017	$	3,012.00
May-2017	$	3,512.00
Nov-2017	$	3,040.00
Oct-2017	$	3,432.00
Sep-2017	$	3,228.00
[redacted]		
Apr-2017	$	-
Aug-2017	$	-
Dec-2017	$	-
Jul-2017	$	-
Jun-2017	$	-
May-2017	$	-
Nov-2017	$	-
Oct-2017	$	-
Sep-2017	$	-
[redacted]		
Apr-2017	$	3,636.00
Aug-2017	$	3,872.00
Dec-2017	$	2,720.00
Feb-2017	$	2,340.00
Jan-2017	$	2,036.00
Jul-2017	$	3,488.00
Jun-2017	$	3,808.00
Mar-2017	$	3,108.00
May-2017	$	3,548.00
Nov-2017	$	3,084.00
Oct-2017	$	3,476.00
Sep-2017	$	3,344.00
[redacted]		
Aug-2017	$	60.00
Feb-2017	$	628.00
Jun-2017	$	1,112.00
Mar-2017	$	436.00
May-2017	$	584.00
[redacted]		
Aug-2017	$	64.00
Feb-2017	$	648.00
Jun-2017	$	1,116.00
Mar-2017	$	460.00
May-2017	$	584.00
[redacted]		
Feb-2017	$	1,392.00
Jul-2017	$	144.00

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Counterparty and Payment Dates		REC Cost
Jun-2017	$	2,520.00
Mar-2017	$	1,020.00
May-2017	$	1,332.00
[redacted]		
Apr-2017	$	3,468.00
Aug-2017	$	3,836.00
Dec-2017	$	2,448.00
Feb-2017	$	1,692.00
Jan-2017	$	1,960.00
Jul-2017	$	3,620.00
Jun-2017	$	3,688.00
Mar-2017	$	3,116.00
May-2017	$	3,548.00
Nov-2017	$	2,976.00
Oct-2017	$	3,080.00
Sep-2017	$	3,280.00
[redacted]		
Apr-2017	$	3,504.00
Aug-2017	$	3,908.00
Dec-2017	$	1,944.00
Feb-2017	$	2,076.00
Jan-2017	$	2,076.00
Jul-2017	$	3,444.00
Jun-2017	$	3,844.00
Mar-2017	$	3,148.00
May-2017	$	3,664.00
Nov-2017	$	3,004.00
Oct-2017	$	3,244.00
Sep-2017	$	3,264.00
[redacted]		
Apr-2017	$	352.17
Aug-2017	$	352.17
Dec-2017	$	234.78
Feb-2017	$	117.39
Jan-2017	$	117.39
Jul-2017	$	469.56
Jun-2017	$	352.17
Mar-2017	$	234.78
May-2017	$	352.17
Nov-2017	$	234.78
Oct-2017	$	352.17
Sep-2017	$	352.17
[redacted]		
Aug-2017	$	332,095.00
Dec-2017	$	289,850.00
Jul-2017	$	339,915.00
Jun-2017	$	239,870.00
May-2017	$	285,260.00
Nov-2017	$	305,235.00
Oct-2017	$	326,910.00
Sep-2017	$	338,045.00
[redacted]		
Apr-2017	$	19,590.00
Aug-2017	$	10,320.00
Dec-2017	$	2,685.00
Feb-2017	$	17,640.00
Jan-2017	$	12,150.00
Jul-2017	$	27,255.00
Jun-2017	$	20,655.00
Mar-2017	$	16,995.00
May-2017	$	13,680.00

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Nov-2017	$	4,050.00
Oct-2017	$	7,650.00
Sep-2017	$	5,415.00
[redacted]		
Apr-2017	$	234.78
Aug-2017	$	469.56
Dec-2017	$	234.78
Feb-2017	$	234.78
Jan-2017	$	234.78
Jul-2017	$	469.56
Jun-2017	$	352.17
Mar-2017	$	117.39
May-2017	$	352.17
Nov-2017	$	352.17
Oct-2017	$	352.17
Sep-2017	$	352.17
[redacted]		
Apr-2017	$	352.17
Aug-2017	$	352.17
Dec-2017	$	352.17
Feb-2017	$	234.78
Jan-2017	$	117.39
Jul-2017	$	469.56
Jun-2017	$	352.17
Mar-2017	$	234.78
May-2017	$	352.17
Nov-2017	$	234.78
Oct-2017	$	469.56
Sep-2017	$	352.17
[redacted]		
Apr-2017	$	3,552.00
Aug-2017	$	3,928.00
Dec-2017	$	2,648.00
Feb-2017	$	2,040.00
Jan-2017	$	2,092.00
Jul-2017	$	3,476.00
Jun-2017	$	3,856.00
Mar-2017	$	3,168.00
May-2017	$	3,680.00
Nov-2017	$	3,116.00
Oct-2017	$	3,316.00
Sep-2017	$	3,488.00
[redacted]		
Apr-2017	$	879.00
Aug-2017	$	1,113.00
Dec-2017	$	789.00
Feb-2017	$	657.00
Jan-2017	$	858.00
Jul-2017	$	1,065.00
Jun-2017	$	1,056.00
Mar-2017	$	705.00
May-2017	$	1,038.00
Nov-2017	$	831.00
Oct-2017	$	1,059.00
Sep-2017	$	1,065.00
[redacted]		
Apr-2017	$	3,625.00
Aug-2017	$	4,035.00
Dec-2017	$	2,850.00
Feb-2017	$	1,895.00
Jan-2017	$	2,090.00

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Counterparty and Payment Dates		REC Cost
Jul-2017	$	3,280.00
Jun-2017	$	3,935.00
Mar-2017	$	3,300.00
May-2017	$	3,850.00
Nov-2017	$	3,220.00
Oct-2017	$	3,230.00
Sep-2017	$	3,300.00
[redacted]		
Apr-2017	$	2,028.00
Aug-2017	$	2,248.00
Dec-2017	$	1,372.00
Feb-2017	$	876.00
Jan-2017	$	1,120.00
Jul-2017	$	2,272.00
Jun-2017	$	2,024.00
Mar-2017	$	1,596.00
May-2017	$	2,040.00
Nov-2017	$	1,696.00
Oct-2017	$	1,860.00
Sep-2017	$	1,956.00
[redacted]		
Apr-2017	$	4,315.00
Aug-2017	$	4,720.00
Dec-2017	$	3,395.00
Feb-2017	$	2,700.00
Jan-2017	$	2,560.00
Jul-2017	$	4,520.00
Jun-2017	$	4,710.00
Mar-2017	$	3,905.00
May-2017	$	4,550.00
Nov-2017	$	3,830.00
Oct-2017	$	3,860.00
Sep-2017	$	4,015.00
[redacted]		
Apr-2017	$	789.75
Aug-2017	$	839.25
Dec-2017	$	614.25
Feb-2017	$	483.75
Jan-2017	$	591.75
Jul-2017	$	866.25
Jun-2017	$	769.50
Mar-2017	$	688.50
May-2017	$	789.75
Nov-2017	$	686.25
Oct-2017	$	783.00
Sep-2017	$	751.50
[redacted]		
Apr-2017	$	3,552.00
Aug-2017	$	3,924.00
Dec-2017	$	2,884.00
Feb-2017	$	2,244.00
Jan-2017	$	2,160.00
Jul-2017	$	3,504.00
Jun-2017	$	3,940.00
Mar-2017	$	3,156.00
May-2017	$	3,688.00
Nov-2017	$	3,208.00
Oct-2017	$	3,284.00
Sep-2017	$	3,440.00
[redacted]		
Apr-2017	$	117.39

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Aug-2017	$	234.78
Jan-2017	$	234.78
Jul-2017	$	117.39
Jun-2017	$	117.39
Mar-2017	$	117.39
May-2017	$	117.39
Nov-2017	$	117.39
Oct-2017	$	117.39
Sep-2017	$	117.39
[redacted]		
Apr-2017	$	370.00
Aug-2017	$	220.00
Dec-2017	$	175.00
Feb-2017	$	635.00
Jan-2017	$	230.00
Jul-2017	$	810.00
Jun-2017	$	850.00
Mar-2017	$	345.00
May-2017	$	655.00
Nov-2017	$	190.00
Oct-2017	$	225.00
Sep-2017	$	155.00
[redacted]		
Apr-2017	$	73.43
Aug-2017	$	73.43
Jan-2017	$	73.43
Jul-2017	$	146.86
Jun-2017	$	220.29
Mar-2017	$	73.43
Nov-2017	$	73.43
Oct-2017	$	73.43
Sep-2017	$	146.86
[redacted]		
Apr-2017	$	3,556.00
Aug-2017	$	3,960.00
Dec-2017	$	2,608.00
Feb-2017	$	2,024.00
Jan-2017	$	2,016.00
Jul-2017	$	3,528.00
Jun-2017	$	3,856.00
Mar-2017	$	3,160.00
May-2017	$	3,676.00
Nov-2017	$	3,088.00
Oct-2017	$	3,344.00
Sep-2017	$	3,532.00
[redacted]		
Apr-2017	$	1,920.00
Aug-2017	$	4,050.00
Dec-2017	$	1,395.00
Feb-2017	$	2,165.00
Jan-2017	$	1,875.00
Jul-2017	$	2,245.00
Jun-2017	$	1,905.00
May-2017	$	1,875.00
Nov-2017	$	1,760.00
Oct-2017	$	2,025.00
[redacted]		
Apr-2017	$	1,851.75
Aug-2017	$	1,926.00
Dec-2017	$	1,426.50
Feb-2017	$	1,176.75

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Jan-2017	$	1,122.75
Jul-2017	$	1,840.50
Jun-2017	$	1,921.50
Mar-2017	$	1,701.00
May-2017	$	1,455.75
Nov-2017	$	1,633.50
Oct-2017	$	1,624.50
Sep-2017	$	1,674.00
[redacted]		
Apr-2017	$	1,847.25
Aug-2017	$	1,939.50
Dec-2017	$	1,379.25
Feb-2017	$	1,138.50
Jan-2017	$	576.00
Jul-2017	$	1,854.00
Jun-2017	$	1,923.75
Mar-2017	$	1,669.50
May-2017	$	1,905.75
Nov-2017	$	1,631.25
Oct-2017	$	1,647.00
Sep-2017	$	1,716.75
[redacted]		
Apr-2017	$	103.43
Aug-2017	$	206.86
Dec-2017	$	103.43
Feb-2017	$	103.43
Jan-2017	$	103.43
Jul-2017	$	103.43
Jun-2017	$	206.86
May-2017	$	103.43
Nov-2017	$	103.43
Oct-2017	$	206.86
Sep-2017	$	103.43
[redacted]		
Apr-2017	$	310.29
Aug-2017	$	413.72
Dec-2017	$	310.29
Feb-2017	$	206.86
Jan-2017	$	206.86
Jul-2017	$	310.29
Jun-2017	$	310.29
Mar-2017	$	103.43
May-2017	$	310.29
Nov-2017	$	206.86
Oct-2017	$	413.72
Sep-2017	$	310.29
[redacted]		
Aug-2017	$	220.29
Dec-2017	$	73.43
Feb-2017	$	73.43
Jun-2017	$	73.43
Mar-2017	$	73.43
May-2017	$	146.86
Nov-2017	$	220.29
Sep-2017	$	146.86
[redacted]		
Apr-2017	$	3,780.00
Aug-2017	$	4,240.00
Dec-2017	$	2,968.00
Feb-2017	$	2,428.00
Jan-2017	$	2,356.00

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Jul-2017	$	3,700.00
Jun-2017	$	4,104.00
Mar-2017	$	3,344.00
May-2017	$	3,824.00
Nov-2017	$	3,296.00
Oct-2017	$	3,572.00
Sep-2017	$	3,552.00
[redacted]		
Apr-2017	$	73.43
Aug-2017	$	146.86
Dec-2017	$	73.43
Jan-2017	$	73.43
Jul-2017	$	146.86
Jun-2017	$	146.86
Mar-2017	$	73.43
May-2017	$	146.86
Nov-2017	$	146.86
Oct-2017	$	146.86
Sep-2017	$	73.43
[redacted]		
Apr-2017	$	4,475.00
Aug-2017	$	4,740.00
Dec-2017	$	3,425.00
Feb-2017	$	2,905.00
Jan-2017	$	2,575.00
Jul-2017	$	4,240.00
Jun-2017	$	4,740.00
Mar-2017	$	3,900.00
May-2017	$	4,415.00
Nov-2017	$	3,805.00
Oct-2017	$	4,275.00
Sep-2017	$	4,075.00
[redacted]		
Apr-2017	$	3,768.00
Aug-2017	$	4,260.00
Dec-2017	$	2,964.00
Feb-2017	$	2,428.00
Jan-2017	$	2,212.00
Jul-2017	$	3,736.00
Jun-2017	$	4,124.00
Mar-2017	$	3,292.00
May-2017	$	3,568.00
Nov-2017	$	3,368.00
Oct-2017	$	3,764.00
Sep-2017	$	3,652.00
[redacted]		
Apr-2017	$	2,049.75
Aug-2017	$	2,207.25
Dec-2017	$	1,671.75
Feb-2017	$	1,401.75
Jan-2017	$	848.25
Jul-2017	$	2,007.00
Jun-2017	$	2,256.75
Mar-2017	$	1,818.00
May-2017	$	2,092.50
Nov-2017	$	1,811.25
Oct-2017	$	1,923.75
Sep-2017	$	1,840.50
[redacted]		
Apr-2017	$	4,380.00
Aug-2017	$	4,655.00

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Counterparty and Payment Dates		REC Cost
Dec-2017	$	3,025.00
Feb-2017	$	1,985.00
Jan-2017	$	2,455.00
Jul-2017	$	4,055.00
Jun-2017	$	4,385.00
Mar-2017	$	3,410.00
May-2017	$	4,315.00
Nov-2017	$	3,640.00
Oct-2017	$	3,960.00
Sep-2017	$	4,150.00
[redacted]		
Apr-2017	$	4,290.00
Aug-2017	$	5,070.00
Dec-2017	$	2,945.00
Feb-2017	$	2,070.00
Jan-2017	$	2,630.00
Jul-2017	$	4,825.00
Jun-2017	$	4,560.00
Mar-2017	$	3,630.00
May-2017	$	4,375.00
Nov-2017	$	2,750.00
Oct-2017	$	4,155.00
Sep-2017	$	4,385.00
[redacted]		
Apr-2017	$	22,579.40
Aug-2017	$	25,166.20
Dec-2017	$	15,729.60
Feb-2017	$	11,298.40
Jan-2017	$	12,284.40
Jul-2017	$	23,107.20
Jun-2017	$	23,629.20
Mar-2017	$	19,232.80
May-2017	$	21,367.20
Nov-2017	$	19,111.00
Oct-2017	$	20,578.40
Sep-2017	$	21,657.20
[redacted]		
Apr-2017	$	3,544.00
Aug-2017	$	4,164.00
Dec-2017	$	2,696.00
Feb-2017	$	1,892.00
Jan-2017	$	2,196.00
Jul-2017	$	4,028.00
Jun-2017	$	3,884.00
Mar-2017	$	3,128.00
May-2017	$	3,816.00
Nov-2017	$	3,244.00
Oct-2017	$	6,804.00
[redacted]		
Apr-2017	$	17,291.88
Aug-2017	$	17,950.11
Dec-2017	$	16,420.17
Feb-2017	$	18,554.97
Jan-2017	$	18,305.52
Jul-2017	$	18,056.85
Jun-2017	$	18,003.48
Mar-2017	$	15,744.15
May-2017	$	15,886.47
Nov-2017	$	17,060.61
Oct-2017	$	15,833.10
Sep-2017	$	17,718.84

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[redacted]		
Apr-2017	$	4,235.00
Aug-2017	$	5,360.00
Dec-2017	$	3,805.00
Feb-2017	$	2,600.00
Jan-2017	$	2,500.00
Jul-2017	$	4,400.00
Jun-2017	$	4,810.00
Mar-2017	$	3,815.00
May-2017	$	4,565.00
Nov-2017	$	4,400.00
Oct-2017	$	4,390.00
Sep-2017	$	4,740.00
[redacted]		
Apr-2017	$	4,330.00
Aug-2017	$	3,945.00
Dec-2017	$	3,505.00
Feb-2017	$	2,740.00
Jan-2017	$	2,270.00
Jul-2017	$	1,445.00
Jun-2017	$	4,470.00
Mar-2017	$	3,660.00
May-2017	$	4,140.00
Nov-2017	$	4,060.00
Oct-2017	$	3,935.00
Sep-2017	$	4,195.00
[redacted]		
Apr-2017	$	3,510.00
Aug-2017	$	3,930.00
Dec-2017	$	2,505.00
Feb-2017	$	1,915.00
Jan-2017	$	1,875.00
Jul-2017	$	3,855.00
Jun-2017	$	3,835.00
Mar-2017	$	3,035.00
May-2017	$	3,690.00
Nov-2017	$	3,065.00
Oct-2017	$	3,355.00
Sep-2017	$	3,610.00
[redacted]		
Apr-2017	$	3,740.00
Aug-2017	$	4,025.00
Dec-2017	$	2,545.00
Feb-2017	$	1,845.00
Jan-2017	$	1,960.00
Jul-2017	$	4,040.00
Jun-2017	$	3,815.00
Mar-2017	$	3,115.00
May-2017	$	3,860.00
Nov-2017	$	3,145.00
Oct-2017	$	3,210.00
Sep-2017	$	3,590.00
[redacted]		
Apr-2017	$	3,752.00
Aug-2017	$	4,236.00
Dec-2017	$	2,448.00
Feb-2017	$	1,884.00
Jan-2017	$	1,928.00
Jul-2017	$	4,112.00
Jun-2017	$	3,932.00
Mar-2017	$	3,180.00

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May-2017	$	3,864.00
Nov-2017	$	3,252.00
Oct-2017	$	3,112.00
Sep-2017	$	3,784.00
[redacted]		
Apr-2017	$	1,396.00
Aug-2017	$	1,520.00
Dec-2017	$	1,084.00
Feb-2017	$	788.00
Jan-2017	$	1,284.00
Jul-2017	$	1,532.00
Jun-2017	$	1,440.00
Mar-2017	$	884.00
May-2017	$	1,340.00
Nov-2017	$	1,276.00
Oct-2017	$	1,432.00
Sep-2017	$	1,364.00
[redacted]		
Apr-2017	$	234.78
Aug-2017	$	234.78
Dec-2017	$	234.78
Feb-2017	$	117.39
Jan-2017	$	234.78
Jul-2017	$	234.78
Jun-2017	$	234.78
Mar-2017	$	234.78
May-2017	$	234.78
Nov-2017	$	234.78
Oct-2017	$	234.78
Sep-2017	$	117.39
[redacted]		
Apr-2017	$	17,725.89
Aug-2017	$	14,908.53
Dec-2017	$	13,265.07
Feb-2017	$	6,221.67
Jan-2017	$	13,617.24
Jul-2017	$	20,778.03
Jun-2017	$	18,782.40
Mar-2017	$	13,382.46
May-2017	$	21,364.98
Nov-2017	$	15,143.31
Oct-2017	$	19,721.52
Sep-2017	$	16,551.99
[redacted]		
Apr-2017	$	3,765.00
Aug-2017	$	4,435.00
Dec-2017	$	3,370.00
Feb-2017	$	2,535.00
Jan-2017	$	2,270.00
Jul-2017	$	4,575.00
Jun-2017	$	4,635.00
Mar-2017	$	3,450.00
May-2017	$	3,740.00
Nov-2017	$	4,010.00
Oct-2017	$	4,070.00
Sep-2017	$	4,395.00
[redacted]		
Apr-2017	$	225,343.13
Aug-2017	$	260,684.49
Dec-2017	$	505,958.76
Feb-2017	$	150,755.50

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Counterparty and Payment Dates		REC Cost
Jan-2017	$	209,692.42
Jul-2017	$	254,824.43
Jun-2017	$	166,401.75
Mar-2017	$	275,966.54
May-2017	$	194,542.92
Nov-2017	$	243,471.81
Oct-2017	$	247,698.34
[redacted]		
Aug-2017	$	31,139.31
Dec-2017	$	8,859.72
Jun-2017	$	28,533.51
Mar-2017	$	3,300.68
May-2017	$	15,895.38
Nov-2017	$	13,723.88
Oct-2017	$	14,983.35
[redacted]		
Apr-2017	$	679.50
Aug-2017	$	1,651.50
Feb-2017	$	866.25
Jan-2017	$	540.00
Jul-2017	$	765.00
Jun-2017	$	758.25
May-2017	$	814.50
Nov-2017	$	1,361.25
Oct-2017	$	783.00
[redacted]		
Apr-2017	$	2,027.25
Aug-2017	$	2,085.75
Dec-2017	$	1,557.00
Feb-2017	$	1,273.50
Jan-2017	$	1,170.00
Jul-2017	$	1,894.50
Jun-2017	$	2,079.00
Mar-2017	$	1,755.00
May-2017	$	1,935.00
Nov-2017	$	1,766.25
Oct-2017	$	1,935.00
Sep-2017	$	1,782.00
[redacted]		
Apr-2017	$	3,740.00
Aug-2017	$	4,292.00
Dec-2017	$	2,648.00
Feb-2017	$	2,088.00
Jan-2017	$	2,220.00
Jul-2017	$	4,172.00
Jun-2017	$	3,956.00
Mar-2017	$	3,152.00
May-2017	$	3,880.00
Nov-2017	$	3,280.00
Oct-2017	$	3,244.00
Sep-2017	$	3,744.00
[redacted]		
Aug-2017	$	6,219,875.00
[redacted]		
Apr-2017	$	4,625.00
Aug-2017	$	4,715.00
Dec-2017	$	3,575.00
Feb-2017	$	3,015.00
Jan-2017	$	2,710.00
Jul-2017	$	4,310.00
Jun-2017	$	4,750.00

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Counterparty and Payment Dates		REC Cost
Mar-2017	$	4,100.00
May-2017	$	4,455.00
Nov-2017	$	4,100.00
Oct-2017	$	4,340.00
Sep-2017	$	4,035.00
[redacted]		
Apr-2017	$	1,977.75
Aug-2017	$	2,081.25
Dec-2017	$	1,948.50
Feb-2017	$	2,400.75
Jan-2017	$	1,982.25
Jul-2017	$	2,364.75
Jun-2017	$	1,125.00
Mar-2017	$	1,973.25
May-2017	$	1,066.50
Nov-2017	$	2,306.25
Oct-2017	$	2,121.75
Sep-2017	$	2,268.00
[redacted]		
Apr-2017	$	2,056.50
Aug-2017	$	2,193.75
Dec-2017	$	1,554.75
Feb-2017	$	1,309.50
Jan-2017	$	1,163.25
Jul-2017	$	1,926.00
Jun-2017	$	2,151.00
Mar-2017	$	1,782.00
May-2017	$	1,991.25
Nov-2017	$	1,797.75
Oct-2017	$	2,002.50
Sep-2017	$	1,872.00
[redacted]		
Apr-2017	$	12,369.22
Aug-2017	$	13,411.57
Dec-2017	$	8,408.29
Feb-2017	$	5,559.20
Jan-2017	$	6,756.90
Jul-2017	$	12,994.63
Jun-2017	$	12,299.73
Mar-2017	$	9,728.60
May-2017	$	10,701.46
Nov-2017	$	10,423.50
Oct-2017	$	11,118.40
Sep-2017	$	11,882.79
[redacted]		
Apr-2017	$	10,942.02
Aug-2017	$	10,915.59
Dec-2017	$	7,479.69
Feb-2017	$	5,164.39
Jan-2017	$	5,863.20
Jul-2017	$	10,942.02
Jun-2017	$	10,096.26
Mar-2017	$	7,083.24
May-2017	$	11,021.31
Nov-2017	$	10,492.71
Oct-2017	$	10,043.40
Sep-2017	$	6,422.49
[redacted]		
Apr-2017	$	4,095.00
Aug-2017	$	4,265.00
Dec-2017	$	2,890.00

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Counterparty and Payment Dates		REC Cost
Feb-2017	$	2,560.00
Jan-2017	$	2,390.00
Jul-2017	$	4,115.00
Jun-2017	$	4,400.00
Mar-2017	$	3,610.00
May-2017	$	4,090.00
Nov-2017	$	3,340.00
Oct-2017	$	3,575.00
Sep-2017	$	3,665.00
[redacted]		
Apr-2017	$	3,891.79
Aug-2017	$	3,818.36
Dec-2017	$	3,010.63
Feb-2017	$	2,349.76
Jan-2017	$	2,129.47
Jul-2017	$	5,433.82
Jun-2017	$	4,479.23
Mar-2017	$	3,304.35
May-2017	$	4,479.23
Nov-2017	$	3,084.06
Sep-2017	$	3,965.22
[redacted]		
Aug-2017	$	3,136.00
Dec-2017	$	2,208.00
Jul-2017	$	2,684.00
Jun-2017	$	2,956.00
May-2017	$	484.00
Nov-2017	$	2,312.00
Oct-2017	$	2,784.00
Sep-2017	$	2,740.00
[redacted]		
Apr-2017	$	4,505.00
Aug-2017	$	4,510.00
Dec-2017	$	3,340.00
Feb-2017	$	2,875.00
Jan-2017	$	2,615.00
Jul-2017	$	4,150.00
Jun-2017	$	4,655.00
Mar-2017	$	4,010.00
May-2017	$	4,270.00
Nov-2017	$	4,000.00
Oct-2017	$	4,370.00
Sep-2017	$	4,085.00
[redacted]		
Apr-2017	$	2,252.50
Aug-2017	$	1,335.00
Dec-2017	$	1,757.50
Feb-2017	$	1,392.50
Jan-2017	$	1,290.00
Jul-2017	$	2,105.00
Jun-2017	$	2,317.50
Mar-2017	$	1,945.00
May-2017	$	2,165.00
Nov-2017	$	1,907.50
Oct-2017	$	2,132.50
Sep-2017	$	2,022.50
[redacted]		
Apr-2017	$	4,740.00
Aug-2017	$	5,445.00
Dec-2017	$	3,710.00
Feb-2017	$	3,040.00

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Jan-2017	$	2,760.00
Jul-2017	$	4,795.00
Jun-2017	$	5,145.00
Mar-2017	$	4,180.00
May-2017	$	4,755.00
Nov-2017	$	4,075.00
Oct-2017	$	4,610.00
Sep-2017	$	4,635.00
[redacted]		
Apr-2017	$	1,284.50
Aug-2017	$	1,412.25
Dec-2017	$	974.75
Feb-2017	$	757.75
Jul-2017	$	1,282.75
Jun-2017	$	1,396.50
Mar-2017	$	1,104.25
May-2017	$	1,274.00
Nov-2017	$	1,107.75
Oct-2017	$	1,293.25
Sep-2017	$	1,211.00
[redacted]		
Apr-2017	$	4,440.00
Aug-2017	$	4,795.00
Dec-2017	$	3,040.00
Feb-2017	$	1,920.00
Jan-2017	$	2,545.00
Jul-2017	$	4,780.00
Jun-2017	$	4,395.00
Mar-2017	$	3,500.00
May-2017	$	4,425.00
Nov-2017	$	3,720.00
Oct-2017	$	3,950.00
Sep-2017	$	4,070.00
[redacted]		
Apr-2017	$	1,580.00
Aug-2017	$	1,536.00
Dec-2017	$	1,192.00
Feb-2017	$	720.00
Jan-2017	$	1,068.00
Jul-2017	$	1,912.00
Jun-2017	$	1,404.00
Mar-2017	$	1,256.00
May-2017	$	1,616.00
Nov-2017	$	1,196.00
Oct-2017	$	1,624.00
Sep-2017	$	1,576.00
[redacted]		
Apr-2017	$	6,516.09
Aug-2017	$	7,860.68
Dec-2017	$	5,068.07
Feb-2017	$	2,999.47
Jan-2017	$	4,137.20
Jul-2017	$	6,929.81
Jun-2017	$	13,859.62
Mar-2017	$	5,895.51
Nov-2017	$	11,170.44
Sep-2017	$	7,240.10
[redacted]		
Apr-2017	$	13,167.00
Aug-2017	$	66,519.00
Dec-2017	$	52,269.00

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Counterparty and Payment Dates		REC Cost
Feb-2017	$	26,230.00
Jan-2017	$	38,613.00
Jul-2017	$	31,749.00
Jun-2017	$	27,873.00
Mar-2017	$	28,557.00
May-2017	$	5,985.00
Nov-2017	$	65,493.00
Oct-2017	$	68,685.00
Sep-2017	$	45,828.00
[redacted]		
Apr-2017	$	2,465.19
Aug-2017	$	2,817.36
Dec-2017	$	1,643.46
Feb-2017	$	1,173.90
Jan-2017	$	1,291.29
Jul-2017	$	2,817.36
Jun-2017	$	2,817.36
Mar-2017	$	1,995.63
May-2017	$	2,582.58
Nov-2017	$	2,113.02
Oct-2017	$	2,347.80
Sep-2017	$	2,465.19
[redacted]		
Aug-2017	$	7,043.70
May-2017	$	13,621.49
Nov-2017	$	7,641.75
[redacted]		
Aug-2017	$	15,084.15
May-2017	$	29,893.84
Nov-2017	$	13,821.60
[redacted]		
Apr-2017	$	3,840.00
Aug-2017	$	3,916.00
Dec-2017	$	3,020.00
Feb-2017	$	2,532.00
Jan-2017	$	2,308.00
Jul-2017	$	3,720.00
Jun-2017	$	4,064.00
Mar-2017	$	3,456.00
May-2017	$	3,668.00
Nov-2017	$	2,908.00
Oct-2017	$	3,748.00
Sep-2017	$	3,564.00
[redacted]		
Apr-2017	$	4,255.00
Aug-2017	$	4,700.00
Dec-2017	$	3,380.00
Feb-2017	$	2,430.00
Jan-2017	$	2,345.00
Jul-2017	$	4,345.00
Jun-2017	$	3,335.00
Mar-2017	$	3,645.00
May-2017	$	4,280.00
Nov-2017	$	3,830.00
Oct-2017	$	4,040.00
Sep-2017	$	4,130.00
[redacted]		
Apr-2017	$	4,485.00
Aug-2017	$	4,580.00
Dec-2017	$	3,235.00
Feb-2017	$	2,515.00

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Jan-2017	$	2,525.00
Jul-2017	$	4,430.00
Jun-2017	$	4,640.00
Mar-2017	$	3,930.00
May-2017	$	4,300.00
Nov-2017	$	3,855.00
Oct-2017	$	4,200.00
Sep-2017	$	4,030.00
[redacted]		
Apr-2017	$	1,552.00
Aug-2017	$	1,644.00
Dec-2017	$	1,188.00
Feb-2017	$	912.00
Jan-2017	$	1,092.00
Jul-2017	$	1,688.00
Jun-2017	$	1,492.00
Mar-2017	$	1,112.00
May-2017	$	1,508.00
Nov-2017	$	1,344.00
Oct-2017	$	1,656.00
Sep-2017	$	1,492.00
[redacted]		
Apr-2017	$	5,941.87
Aug-2017	$	5,686.00
Dec-2017	$	4,292.93
Feb-2017	$	1,692.60
Jan-2017	$	4,334.52
Jul-2017	$	6,112.45
Jun-2017	$	5,202.69
Mar-2017	$	4,605.66
May-2017	$	5,771.29
Nov-2017	$	4,662.52
Oct-2017	$	5,430.13
Sep-2017	$	5,572.28
[redacted]		
Apr-2017	$	3,650.00
Aug-2017	$	4,630.00
Dec-2017	$	2,785.00
Feb-2017	$	1,930.00
Jan-2017	$	2,110.00
Jul-2017	$	4,600.00
Jun-2017	$	4,400.00
Mar-2017	$	3,460.00
May-2017	$	4,285.00
Nov-2017	$	2,835.00
Oct-2017	$	3,715.00
Sep-2017	$	4,145.00
[redacted]		
May-2017	$	675.00
[redacted]		
May-2017	$	465.00
[redacted]		
Apr-2017	$	23,057.50
Aug-2017	$	35,416.32
Dec-2017	$	15,310.18
Feb-2017	$	6,456.10
Jan-2017	$	11,252.06
Jul-2017	$	33,018.34
Jun-2017	$	26,746.70
Mar-2017	$	10,329.76
May-2017	$	24,164.26

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Counterparty and Payment Dates		REC Cost
Nov-2017	$	20,843.98
Oct-2017	$	25,086.56
Sep-2017	$	27,669.00
[redacted]		
Apr-2017	$	2,025.00
Aug-2017	$	2,162.25
Dec-2017	$	1,509.75
Feb-2017	$	1,320.75
Jan-2017	$	1,181.25
Jul-2017	$	1,908.00
Jun-2017	$	2,076.75
Mar-2017	$	1,788.75
May-2017	$	1,955.25
Nov-2017	$	1,660.50
Oct-2017	$	1,975.50
Sep-2017	$	1,872.00
[redacted]		
Apr-2017	$	897.75
Aug-2017	$	888.75
Dec-2017	$	616.50
Feb-2017	$	461.25
Jan-2017	$	477.00
Jul-2017	$	479.25
Jun-2017	$	765.00
Mar-2017	$	578.25
May-2017	$	758.25
Nov-2017	$	659.25
Oct-2017	$	690.75
Sep-2017	$	873.00
[redacted]		
Apr-2017	$	5,481.79
Aug-2017	$	5,792.08
Dec-2017	$	3,930.34
Feb-2017	$	2,585.75
Jan-2017	$	3,826.91
Jul-2017	$	7,033.24
Jun-2017	$	6,205.80
Mar-2017	$	3,309.76
May-2017	$	6,309.23
Nov-2017	$	4,654.35
Oct-2017	$	5,895.51
Sep-2017	$	5,792.08
[redacted]		
Apr-2017	$	1,980.00
Aug-2017	$	2,135.25
Dec-2017	$	1,037.25
Feb-2017	$	1,183.50
Jan-2017	$	1,129.50
Jul-2017	$	1,935.00
Jun-2017	$	2,036.25
Mar-2017	$	1,741.50
May-2017	$	2,016.00
Nov-2017	$	1,759.50
Oct-2017	$	1,829.25
Sep-2017	$	1,939.50
[redacted]		
Apr-2017	$	4,425.00
Aug-2017	$	4,815.00
Dec-2017	$	3,495.00
Feb-2017	$	2,855.00
Jan-2017	$	2,680.00

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Jul-2017	$	4,245.00
Jun-2017	$	4,715.00
Mar-2017	$	3,835.00
May-2017	$	4,460.00
Nov-2017	$	3,845.00
Oct-2017	$	4,265.00
Sep-2017	$	3,970.00
[redacted]		
Apr-2017	$	3,748.00
Aug-2017	$	3,892.00
Dec-2017	$	2,864.00
Feb-2017	$	2,208.00
Jan-2017	$	2,172.00
Jul-2017	$	3,992.00
Jun-2017	$	3,016.00
Mar-2017	$	3,308.00
May-2017	$	3,832.00
Nov-2017	$	3,320.00
Oct-2017	$	3,696.00
Sep-2017	$	3,528.00
[redacted]		
Apr-2017	$	3,780.00
Aug-2017	$	4,104.00
Dec-2017	$	2,932.00
Feb-2017	$	2,276.00
Jan-2017	$	2,292.00
Jul-2017	$	3,936.00
Jun-2017	$	4,080.00
Mar-2017	$	3,468.00
May-2017	$	3,960.00
Nov-2017	$	3,368.00
Oct-2017	$	3,316.00
Sep-2017	$	3,700.00
[redacted]		
Apr-2017	$	2,775.00
Aug-2017	$	2,985.00
Dec-2017	$	1,865.00
Feb-2017	$	1,240.00
Jan-2017	$	1,530.00
Jul-2017	$	2,935.00
Jun-2017	$	2,705.00
Mar-2017	$	2,135.00
May-2017	$	2,730.00
Nov-2017	$	2,145.00
Oct-2017	$	2,510.00
Sep-2017	$	2,590.00
[redacted]		
Apr-2017	$	9,640.00
Aug-2017	$	4,760.00
Dec-2017	$	3,490.00
Feb-2017	$	2,980.00
Jan-2017	$	2,645.00
Jul-2017	$	4,195.00
Jun-2017	$	4,725.00
Mar-2017	$	4,000.00
May-2017	$	4,385.00
Nov-2017	$	3,890.00
Oct-2017	$	4,285.00
Sep-2017	$	3,825.00
[redacted]		
Apr-2017	$	4,095.00

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Aug-2017	$	4,345.00
Dec-2017	$	2,825.00
Feb-2017	$	2,225.00
Jan-2017	$	2,195.00
Jul-2017	$	4,055.00
Jun-2017	$	4,300.00
Mar-2017	$	3,505.00
May-2017	$	3,505.00
Nov-2017	$	3,585.00
Oct-2017	$	3,920.00
Sep-2017	$	3,805.00
[redacted]		
Apr-2017	$	4,385.00
Aug-2017	$	4,865.00
Dec-2017	$	3,015.00
Feb-2017	$	1,950.00
Jan-2017	$	2,375.00
Jul-2017	$	4,795.00
Jun-2017	$	4,330.00
Mar-2017	$	3,395.00
May-2017	$	4,305.00
Nov-2017	$	3,670.00
Oct-2017	$	3,995.00
Sep-2017	$	4,195.00
[redacted]		
Apr-2017	$	62,595.00
Aug-2017	$	35,630.00
Dec-2017	$	8,210.00
Feb-2017	$	32,580.00
Jan-2017	$	27,395.00
Jul-2017	$	32,375.00
Jun-2017	$	23,765.00
May-2017	$	35,675.00
Nov-2017	$	22,310.00
Oct-2017	$	28,270.00
Sep-2017	$	31,935.00
[redacted]		
Apr-2017	$	2,764.00
Aug-2017	$	3,700.00
Dec-2017	$	2,448.00
Feb-2017	$	1,568.00
Jan-2017	$	1,796.00
Jul-2017	$	3,756.00
Jun-2017	$	3,616.00
Mar-2017	$	2,752.00
May-2017	$	3,400.00
Nov-2017	$	3,040.00
Oct-2017	$	3,312.00
Sep-2017	$	3,384.00
[redacted]		
Apr-2017	$	3,980.00
Aug-2017	$	4,925.00
Dec-2017	$	3,325.00
Feb-2017	$	2,065.00
Jan-2017	$	2,700.00
Jul-2017	$	3,395.00
Jun-2017	$	4,560.00
Mar-2017	$	3,380.00
May-2017	$	4,515.00
Nov-2017	$	3,930.00
Oct-2017	$	4,085.00

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Sep-2017	$	4,230.00
[redacted]		
Apr-2017	$	4,320.00
Aug-2017	$	4,900.00
Dec-2017	$	3,710.00
Feb-2017	$	2,930.00
Jan-2017	$	2,825.00
Jul-2017	$	4,460.00
Jun-2017	$	4,990.00
Mar-2017	$	3,940.00
May-2017	$	4,675.00
Nov-2017	$	4,005.00
Oct-2017	$	4,315.00
Sep-2017	$	4,100.00
[redacted]		
Apr-2017	$	33,390.14
Aug-2017	$	40,575.36
Dec-2017	$	21,344.33
Feb-2017	$	11,200.49
Jan-2017	$	10,106.25
Jul-2017	$	40,364.03
Jun-2017	$	44,801.96
Mar-2017	$	25,782.26
May-2017	$	38,250.73
Nov-2017	$	16,906.40
Oct-2017	$	24,514.28
Sep-2017	$	28,952.21
[redacted]		
Apr-2017	$	4,605.00
Aug-2017	$	4,765.00
Dec-2017	$	3,380.00
Feb-2017	$	3,005.00
Jan-2017	$	2,665.00
Jul-2017	$	3,870.00
Jun-2017	$	4,925.00
Mar-2017	$	4,095.00
May-2017	$	4,490.00
Nov-2017	$	3,975.00
Oct-2017	$	4,470.00
Sep-2017	$	4,135.00
[redacted]		
Apr-2017	$	2,582.58
Aug-2017	$	3,756.48
Dec-2017	$	2,347.80
Feb-2017	$	1,291.29
Jan-2017	$	1,760.85
Jul-2017	$	4,460.82
Jun-2017	$	3,521.70
Mar-2017	$	1,526.07
May-2017	$	3,169.53
Nov-2017	$	2,699.97
Oct-2017	$	3,756.48
Sep-2017	$	3,756.48
[redacted]		
Apr-2017	$	4,790.00
Aug-2017	$	5,235.00
Dec-2017	$	3,115.00
Feb-2017	$	2,620.00
Jan-2017	$	2,725.00
Jul-2017	$	5,100.00
Jun-2017	$	5,130.00

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Mar-2017	$	4,085.00
May-2017	$	4,735.00
Nov-2017	$	3,795.00
Oct-2017	$	4,215.00
Sep-2017	$	4,745.00
[redacted]		
Apr-2017	$	3,784.00
Aug-2017	$	4,112.00
Dec-2017	$	2,728.00
Feb-2017	$	2,104.00
Jan-2017	$	2,132.00
Jul-2017	$	3,740.00
Jun-2017	$	3,996.00
Mar-2017	$	3,284.00
May-2017	$	3,648.00
Nov-2017	$	3,288.00
Oct-2017	$	3,520.00
Sep-2017	$	3,536.00
[redacted]		
Apr-2017	$	234.78
Aug-2017	$	352.17
Dec-2017	$	234.78
Feb-2017	$	234.78
Jan-2017	$	234.78
Jul-2017	$	352.17
Jun-2017	$	352.17
Mar-2017	$	234.78
May-2017	$	352.17
Nov-2017	$	352.17
Oct-2017	$	352.17
Sep-2017	$	352.17
[redacted]		
Apr-2017	$	5,068.07
Aug-2017	$	7,136.67
Dec-2017	$	3,723.48
Feb-2017	$	2,482.32
Jan-2017	$	3,309.76
Jul-2017	$	5,895.51
Jun-2017	$	3,413.19
Mar-2017	$	3,826.91
May-2017	$	5,895.51
Nov-2017	$	4,550.92
Oct-2017	$	5,895.51
Sep-2017	$	5,585.22
[redacted]		
Jul-2017	$	570.00
[redacted]		
Apr-2017	$	15,663.00
Aug-2017	$	17,250.00
Dec-2017	$	11,937.00
Feb-2017	$	9,987.75
Jan-2017	$	9,108.00
Jul-2017	$	15,042.00
Jun-2017	$	16,870.50
Mar-2017	$	13,334.25
May-2017	$	15,887.25
Nov-2017	$	12,558.00
Oct-2017	$	15,283.50
Sep-2017	$	14,576.25
[redacted]		
Apr-2017	$	2,720.00

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Counterparty and Payment Dates		REC Cost
Aug-2017	$	2,836.00
Dec-2017	$	1,840.00
Feb-2017	$	1,584.00
Jan-2017	$	1,552.00
Jul-2017	$	2,752.00
Jun-2017	$	2,820.00
Mar-2017	$	2,400.00
May-2017	$	2,824.00
Nov-2017	$	2,244.00
Oct-2017	$	2,352.00
Sep-2017	$	2,512.00
[redacted]		
Apr-2017	$	4,290.00
Aug-2017	$	4,765.00
Dec-2017	$	3,250.00
Feb-2017	$	2,645.00
Jan-2017	$	1,380.00
Jul-2017	$	4,460.00
Jun-2017	$	4,750.00
Mar-2017	$	3,930.00
May-2017	$	4,620.00
Nov-2017	$	3,840.00
Oct-2017	$	4,020.00
Sep-2017	$	4,235.00
[redacted]		
Apr-2017	$	4,585.00
Aug-2017	$	5,110.00
Dec-2017	$	3,450.00
Feb-2017	$	2,940.00
Jan-2017	$	1,620.00
Jul-2017	$	4,505.00
Jun-2017	$	4,910.00
Mar-2017	$	4,045.00
May-2017	$	4,560.00
Nov-2017	$	3,990.00
Oct-2017	$	4,185.00
Sep-2017	$	3,870.00
[redacted]		
Apr-2017	$	-
Aug-2017	$	13,541.03
Dec-2017	$	84,337.00
Feb-2017	$	-
Jan-2017	$	-
Jul-2017	$	-
Jun-2017	$	-
Mar-2017	$	-
May-2017	$	-
Nov-2017	$	97,478.00
Oct-2017	$	87,023.00
Sep-2017	$	97,342.00
[redacted]		
Apr-2017	$	3,644.00
Aug-2017	$	4,088.00
Dec-2017	$	2,280.00
Feb-2017	$	1,536.00
Jan-2017	$	1,768.00
Jul-2017	$	3,504.00
Jun-2017	$	3,728.00
Mar-2017	$	2,840.00
May-2017	$	3,600.00
Nov-2017	$	2,936.00

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Counterparty and Payment Dates		REC Cost
Oct-2017	$	3,340.00
Sep-2017	$	3,604.00
[redacted]		
Apr-2017	$	1,800.00
Aug-2017	$	2,135.00
Dec-2017	$	1,330.00
Feb-2017	$	840.00
Jan-2017	$	1,215.00
Jul-2017	$	1,980.00
Jun-2017	$	1,585.00
Mar-2017	$	1,375.00
May-2017	$	2,035.00
Nov-2017	$	1,515.00
Oct-2017	$	1,895.00
Sep-2017	$	1,810.00
[redacted]		
Apr-2017	$	4,370.00
Aug-2017	$	4,760.00
Dec-2017	$	3,090.00
Feb-2017	$	2,015.00
Jan-2017	$	2,550.00
Jul-2017	$	4,185.00
Jun-2017	$	4,345.00
Mar-2017	$	3,485.00
May-2017	$	4,355.00
Nov-2017	$	3,700.00
Oct-2017	$	4,050.00
Sep-2017	$	4,180.00
[redacted]		
Apr-2017	$	4,530.00
Aug-2017	$	4,705.00
Dec-2017	$	3,475.00
Feb-2017	$	2,955.00
Jan-2017	$	2,615.00
Jul-2017	$	4,440.00
Jun-2017	$	4,715.00
Mar-2017	$	4,010.00
May-2017	$	4,370.00
Nov-2017	$	4,095.00
Oct-2017	$	4,375.00
Sep-2017	$	4,130.00
[redacted]		
Apr-2017	$	3,704.00
Aug-2017	$	4,124.00
Dec-2017	$	2,712.00
Feb-2017	$	2,220.00
Jan-2017	$	2,120.00
Jul-2017	$	3,880.00
Jun-2017	$	4,024.00
Mar-2017	$	3,168.00
May-2017	$	3,600.00
Nov-2017	$	3,276.00
Oct-2017	$	3,620.00
Sep-2017	$	3,516.00
[redacted]		
Apr-2017	$	3,812.00
Aug-2017	$	4,216.00
Dec-2017	$	2,760.00
Feb-2017	$	2,420.00
Jan-2017	$	2,216.00
Jul-2017	$	4,000.00

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Jun-2017	$	4,124.00
Mar-2017	$	3,296.00
May-2017	$	3,692.00
Nov-2017	$	3,316.00
Oct-2017	$	3,640.00
Sep-2017	$	3,696.00
[redacted]		
Apr-2017	$	4,615.00
Aug-2017	$	3,475.00
Dec-2017	$	3,235.00
Feb-2017	$	2,025.00
Jan-2017	$	2,815.00
Jul-2017	$	4,455.00
Jun-2017	$	4,335.00
Mar-2017	$	3,600.00
May-2017	$	4,280.00
Nov-2017	$	4,015.00
Oct-2017	$	7,120.00
Sep-2017	$	2,900.00
[redacted]		
Apr-2017	$	3,304.35
Aug-2017	$	4,479.23
Dec-2017	$	2,570.05
Feb-2017	$	1,395.17
Jan-2017	$	2,129.47
Jul-2017	$	4,332.37
Jun-2017	$	3,671.50
Mar-2017	$	2,129.47
May-2017	$	4,038.65
Nov-2017	$	3,304.35
Oct-2017	$	3,744.93
Sep-2017	$	3,744.93
[redacted]		
Apr-2017	$	2,185.00
Aug-2017	$	2,245.00
Dec-2017	$	1,722.50
Feb-2017	$	1,437.50
Jan-2017	$	1,262.50
Jul-2017	$	1,995.00
Jun-2017	$	2,287.50
Mar-2017	$	1,930.00
May-2017	$	2,122.50
Nov-2017	$	1,957.50
Oct-2017	$	2,152.50
Sep-2017	$	1,987.50
[redacted]		
Apr-2017	$	4,345.00
Aug-2017	$	4,595.00
Dec-2017	$	3,290.00
Feb-2017	$	2,640.00
Jan-2017	$	2,600.00
Jul-2017	$	4,225.00
Jun-2017	$	4,600.00
Mar-2017	$	3,995.00
May-2017	$	4,500.00
Nov-2017	$	3,745.00
Oct-2017	$	3,605.00
Sep-2017	$	4,000.00
[redacted]		
Apr-2017	$	4,315.00
Aug-2017	$	4,585.00

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Dec-2017	$	3,450.00
Feb-2017	$	1,745.00
Jan-2017	$	2,645.00
Jul-2017	$	4,310.00
Jun-2017	$	4,620.00
Mar-2017	$	3,685.00
May-2017	$	4,515.00
Nov-2017	$	3,915.00
Oct-2017	$	3,890.00
Sep-2017	$	4,185.00
[redacted]		
Apr-2017	$	4,120.00
Aug-2017	$	4,520.00
Dec-2017	$	3,285.00
Feb-2017	$	2,490.00
Jan-2017	$	2,535.00
Jul-2017	$	4,290.00
Jun-2017	$	4,405.00
Mar-2017	$	3,930.00
May-2017	$	4,400.00
Nov-2017	$	3,830.00
Oct-2017	$	3,740.00
Sep-2017	$	3,960.00
[redacted]		
Apr-2017	$	3,688.00
Aug-2017	$	4,016.00
Dec-2017	$	2,796.00
Feb-2017	$	2,056.00
Jan-2017	$	2,148.00
Jul-2017	$	3,844.00
Jun-2017	$	3,952.00
Mar-2017	$	3,220.00
May-2017	$	2,992.00
Nov-2017	$	3,260.00
Oct-2017	$	3,404.00
Sep-2017	$	3,724.00
[redacted]		
Aug-2017	$	1,965.17
Dec-2017	$	620.58
Feb-2017	$	1,034.30
Jul-2017	$	1,344.59
Jun-2017	$	1,344.59
Mar-2017	$	827.44
May-2017	$	1,137.73
Nov-2017	$	1,965.17
Sep-2017	$	1,137.73
[redacted]		
Apr-2017	$	4,250.00
Aug-2017	$	4,450.00
Dec-2017	$	3,145.00
Feb-2017	$	2,320.00
Jan-2017	$	2,480.00
Jul-2017	$	4,310.00
Jun-2017	$	4,205.00
Mar-2017	$	3,760.00
May-2017	$	4,280.00
Nov-2017	$	3,740.00
Oct-2017	$	3,655.00
Sep-2017	$	4,025.00
[redacted]		
Apr-2017	$	3,496.00

Information in italics is confidential

Duke Energy Progress, LLC
Docket No. E-2, Sub 1175
2017 REPS Compliance Report
Dates and Amounts of payments for RECs - Calendar Year 2017
Redacted Version*

Jennings Exhibit No. 1
Appendix 1
June 20, 2018

Counterparty and Payment Dates		REC Cost
Aug-2017	$	3,820.00
Dec-2017	$	2,720.00
Feb-2017	$	2,256.00
Jan-2017	$	2,144.00
Jul-2017	$	3,600.00
Jun-2017	$	3,912.00
Mar-2017	$	3,168.00
May-2017	$	3,696.00
Nov-2017	$	3,124.00
Oct-2017	$	3,152.00
Sep-2017	$	3,328.00
[redacted]		
Apr-2017	$	454.50
Aug-2017	$	491.00
Dec-2017	$	309.00
Jul-2017	$	493.00
Jun-2017	$	454.50
Mar-2017	$	554.50
May-2017	$	306.00
Nov-2017	$	366.50
Oct-2017	$	415.50
Sep-2017	$	429.50
[redacted]		
Apr-2017	$	4,590.00
Aug-2017	$	5,215.00
Dec-2017	$	3,135.00
Feb-2017	$	1,975.00
Jan-2017	$	2,655.00
Jul-2017	$	4,940.00
Jun-2017	$	4,550.00
Mar-2017	$	3,575.00
May-2017	$	4,315.00
Nov-2017	$	3,950.00
Oct-2017	$	4,190.00
Sep-2017	$	4,430.00
[redacted]		
Apr-2017	$	3,648.00
Aug-2017	$	4,060.00
Dec-2017	$	2,444.00
Feb-2017	$	1,536.00
Jan-2017	$	2,100.00
Jul-2017	$	3,896.00
Jun-2017	$	3,552.00
Mar-2017	$	2,808.00
May-2017	$	3,404.00
Nov-2017	$	3,068.00
Oct-2017	$	3,288.00
Sep-2017	$	3,524.00
[redacted]		
Apr-2017	$	2,013.75
Aug-2017	$	2,209.50
Dec-2017	$	1,352.25
Feb-2017	$	857.25
Jan-2017	$	1,172.25
Jul-2017	$	2,085.75
Jun-2017	$	1,946.25
Mar-2017	$	1,543.50
May-2017	$	1,856.25
Nov-2017	$	1,687.50
Oct-2017	$	1,806.75
Sep-2017	$	1,881.00

*Information in italics is confidential

Duke Energy Progress, LLC
Docket No. E-2, Sub 1175
2017 REPS Compliance Report
Dates and Amounts of payments for RECs - Calendar Year 2017
Redacted Version*

Jennings Exhibit No. 1
Appendix 1
June 20, 2018

Counterparty and Payment Dates		REC Cost
[redacted]		
Apr-2017	$	2,961.00
Aug-2017	$	3,237.00
Dec-2017	$	2,280.00
Feb-2017	$	1,893.00
Jan-2017	$	1,566.00
Jul-2017	$	2,838.00
Jun-2017	$	3,135.00
Mar-2017	$	2,442.00
May-2017	$	2,901.00
Nov-2017	$	2,592.00
Oct-2017	$	2,919.00
Sep-2017	$	2,757.00
[redacted]		
Apr-2017	$	3,880.00
Aug-2017	$	4,288.00
Dec-2017	$	2,840.00
Feb-2017	$	2,388.00
Jan-2017	$	2,076.00
Jul-2017	$	3,756.00
Jun-2017	$	4,160.00
Mar-2017	$	3,320.00
May-2017	$	3,824.00
Nov-2017	$	3,384.00
Oct-2017	$	3,824.00
Sep-2017	$	3,628.00

*Information in italics is confidential

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REDACTED VERSION

DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
1	[redacted]									
2										
3										
4										
5										
6										
7										
8										
9										
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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
30	[redacted]									
31										
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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
59	[redacted]									
60										
61										
62										
63										
64										
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67										
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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
88	[redacted]									
89										
90										
91										
92										
93										
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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	EMF Period April 1, 2017 - March 31, 2018 RECs only	Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost
117	[redacted]								
118									
119									
120									
121									
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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
146	[redacted]									
147										
148										
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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
175	[redacted]									
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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
204	[redacted]									
205										
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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
231	[redacted]									
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DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs
256	[redacted]									
257										
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266										
267	Other Incremental Cost (see Jennings Exhibit No. 3 for Incremental Cost worksheet)				$ 1,512,852				$ 1,630,000	
268	Billing Period estimated credits for receipts related to contracts (see Jennings Exhibit No. 3)				$ -	Note 1			$ (650,000)	Note 1
269	Solar Rebate Program (see Jennings Exhibit No. 3 for cost detail)				$ -				$ 1,061,000	
270	Research (see Jennings Exhibit No. 3 for Research cost detail)				$ 543,992				$ 685,000	
271	**Total Research and Other Incremental Cost**				**$ 2,056,844**				**$ 2,726,000**	
272	***Total REPS Cost - to Williams Exhibit No. 1***				**$ 242,051,697**				**$ 220,952,269**	
273	EMF Period actual credits for receipts related to contracts - to Williams Exhibit No.4 - footnote (2)				$ (639,200)	Note 1 Jennings Exhibit No.3				

DUKE ENERGY PROGRESS, LLC
Docket No. E-2, Sub 1175

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2017 - March 31, 2018 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2018 - November 30, 2019 Total Units Note 3	Cost per Unit	Total Cost	RECs

Notes:

Note 1: EMF Period contract receipts are not included in the under/overcollection calculation on Williams Exhibit No. 2, instead they are credited directly to customer class on Williams Exhibit No. 4. Estimated contract receipts are included in Billing Period total other incremental cost as a reduction in REPS charges proposed for the Billing Period.

Note 2: The revenue requirements associated with each of the Company's solar generating facilities were included in total in the Company's base rate case in Docket No. E-2, Sub 1142. The Commission accepted DEP's conclusion that the facility costs included in its proposed base rates were prudently incurred and approved recovery through base rates.

Note 3: Total units refers to MWhs for bundled energy and REC purchases or to RECs for purchases denoted as RECs only.

1A

DUKE ENERGY PROGRESS, LLC
E-2, Sub 1175
Incremental and research cost worksheet

REDACTED VERSION

Note: all amounts detailed below represent costs applicable to NC REPS compliance only and charged specifically to DEP. Costs below explicitly exclude any interconnection-related amounts for both the EMF Period and the Billing Period

Line No.	Incremental Cost Worksheet:	EMF Period Apr 2017 - Mar 2018	Projected Billing Period Dec 2018 - Nov 2019
	Labor by activity:		
1	[redacted]		
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22	Total Other Incremental Cost	$ 1,512,852	$ 1,630,000
	Solar Rebate Program Cost Detail (recovery in REPS pursuant to G.S. 62-155(f)): (1)		
23	Annual Amortization of Incentives Provided to Customers	-	$ 1,012,000
24	Annual Amortization of Program Administrative Labor Costs		[redacted]
25	Annual Amortization of Program Administrative Non-Labor Costs		
26	Total Solar Rebate Program Cost	$ -	$ 1,061,000

(1) All annual Solar Rebate Program costs reflect amortization of incurred costs over 20 years, including a return on the unamortized balance.

REDACTED VERSION

Line No.	Incremental Cost Worksheet:	EMF Period Apr 2017 - Mar 2018	Projected Billing Period Dec 2018 - Nov 2019
	Research Cost Detail:		
27	CAPER - PV Synchronous Generator	[redacted]	
28	CAPER - Distributed Generation Valuation		
29	Coalition for Renewable Natural Gas membership		
30	eLab - Rocky Mountain Institute		
31	Electric Power Research Institute - EPRI		
32	Eos Energy Storage Technology Development @ McAlpine		
33	FREEDM Center - NC State		
34	IEEE 1547 Conformity Assesment - IEEE Standards Association		
35	IEEE 1547 Conformity Assesment - Clemson University		
36	Islanding Detection & Control - Green Energy Corp		
37	Islanding Detection & Control - Northern Plains Power Technologies		
38	Marshall Solar Site Algorithm - UNCC		
39	Mini-DVAR Project - American SuperConductor		
40	Mini-DVAR Project - IJUS		
41	Mini-DVAR Project - MasTec		
42	Mini-DVAR Project - Schweitzer Engineering Laboratories		
43	Mini-DVAR Project - Various		
44	Swine Extrusion/Poultry Mortality - NC State Natural Resources Foundation		
45	**Total Research Cost:**	$ 543,992	$ 685,000
	Summary:		
46	**Total Other Incremental Cost**	$ 1,512,852	$ 1,630,000
47	Projected receipts related to contract amendments/liquidated damages, etc - see Note 1		$ (650,000)
48	**Total other incremental cost and other credits - Jennings Exhibit No. 2**	$ 1,512,852	$ 980,000
49	**Total Solar Rebate Program Cost, Jennings Exhibit No. 2**	$ -	$ 1,061,000
50	**Total Research Cost - Jennings Exhibit No. 2**	$ 543,992	$ 685,000
51	**Grand Total - other incremental, Solar Rebate Program and research cost, other credits**	$ 2,056,844	$ 2,726,000
52	EMF Period actual credits for receipts related to contracts - to Williams Exhibit No.4 - footnote (2) - see Note 1	$ (639,200)	$ -
53	**Net Other Incremental, Solar Rebate Program and Research Cost**	$ 1,417,644	$ 2,726,000

Note 1: EMF Period contract receipts are not included in the under/overcollection calculation on Williams Exhibit No. 2, instead they are credited directly to customer class on Williams Exhibit No. 4. Estimated contract receipts are included in Billing Period total other incremental cost as a reduction in REPS charges proposed for the Billing Period.

1A

Jennings Exhibit No. 4
Docket No. E-2, Sub 1175

CAPER PVSG Project Progress Report

PI: Alex Huang

Dec 13, 2017

Dr. Huang's team has previously developed a single phase PVSG, this work has been accomplished and one paper was published. See paper in "Integration of DC Microgrids as Virtual Synchronous Machines Into the AC Grid," in *IEEE Transactions on Industrial Electronics*, vol. 64, no. 9, pp. 7455-7466, Sept. 2017. The CAPER project focus is on development and demonstration of a 40 KW three PVSG system. In particularly, the architecture is changed so that the concept can work with existing PV installations. So far, the following major accomplishments have been made:

1. Hardware architecture defined and major components/subsystem in place
2. New control architecture proposed and simulated. A typical simulation result is shown in Figure 1.
3. PVSG controller hardware design finished and manufacturing is underway
4. System rack in place and ready for hardware integration

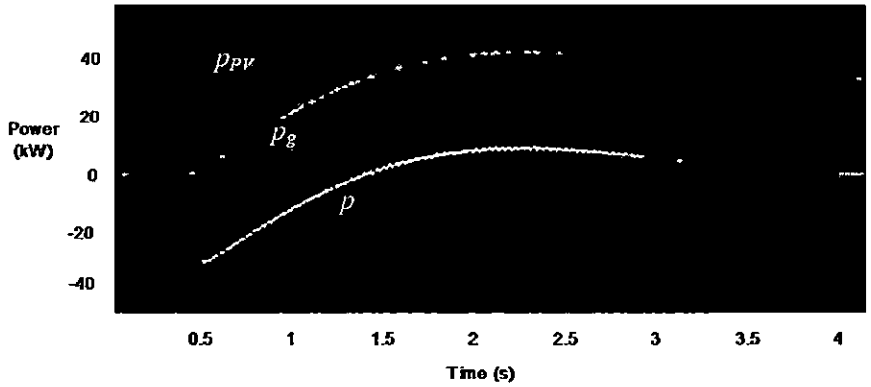


Figure 1 Virtual inertia simulation when there is a sudden increase in irradiation level

Table below shows a summary of remaining work. The remaining work are

1) Manufacturing and testing of a new digital controller needed for the PVSG
2) Software coding of the control system
3) Hardware integration and testing
4) Summary, report and publication.

Tasks \ Month / Gantt bar	1st 2017 6	2nd 2017 7	3rd 2017 8	4th 2017 9	5th 2017 10	6th 2017 11	7th 2017 12	8th 2018 1	9th 2018 2	10th 2018 3	11th 2018 4	12th 2018 5
Analysis of the function for PVSG												
Literature review & Modeling & Control design & Simulation												
Hardware design & PCB												
Platform built & coding												
Experiment and improvement												
Writing of papers												

Current date

Jennings Exhibit No. 5
Docket No. E-2, Sub 1175

CAPER

Center for Advanced Power Engineering Research

How State Regulators are Attributing Costs and Benefits to Distributed Generation

Phase I: A Review of Distributed Generation Valuation Studies and Methodologies

Mesut Baran, Autumn Proudlove, Badrul Chowdhury,
Keith Dsouza, Sumedh Halbe, Micah Thomas

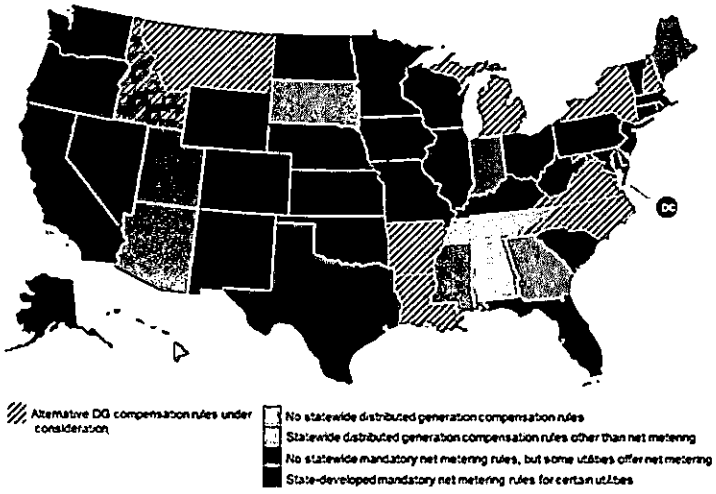
Abstract

The first phase of the project aims to review recently conducted studies on the value of distributed generation. This report provides the findings of this phase of the project. A number of widely available reports on distributed generation valuation are reviewed to determine the methods used to quantify the cost/benefit components across eleven components. Core categories included in almost every study were avoided energy, avoided generation capacity, avoided transmission and distribution capacity, and system/line losses. Most studies also included solar integration costs and at least some environmental benefits. However, it is noted that each study utilizes different assumptions and methods in calculating these components. A summary of the methodologies adopted in these studies for each component is provided.

Introduction

As more distributed solar is being added to the electric grid, states and utilities are reevaluating the way in which customer-generators are compensated. In the vast majority of U.S. states (as Figure 1 shows) these customers have been compensated through a mechanism called net metering. Under net metering, a customer's total kilowatt-hour (kWh) energy production and consumption over the billing period are netted. States differ in their policies for compensating monthly net excess generation; some states allow these credits to roll over month-to-month at the full retail rate, while others may credit this net excess at the avoided cost rate or reduce the credit after a certain period of time.

Figure 1: Net Metering and DG Compensation Policies (Oct. 2017)

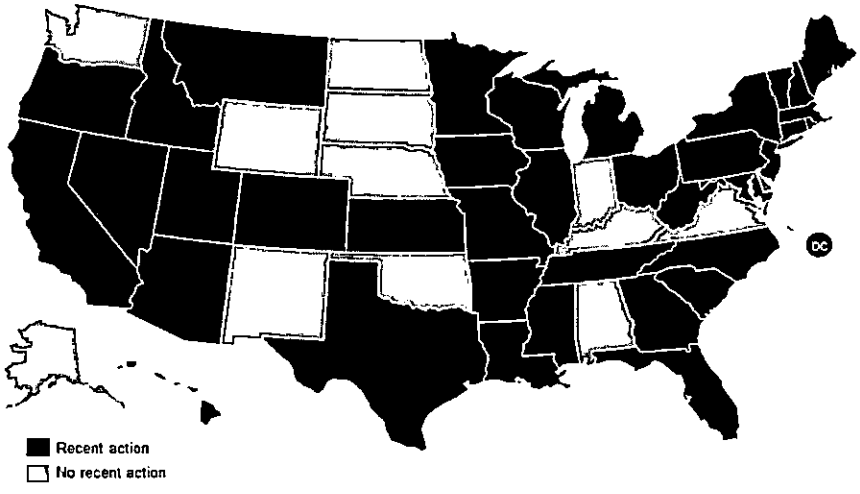


Source: NC Clean Energy Technology Center, 50 States of Solar Q3 2017, October 2017

While net metering has been the dominant compensation structure for distributed solar for many years, a growing number of states are examining alternatives to net metering, including net billing and buy-all, sell-all structures. At the heart of these net metering successor discussions is how the credit rate for excess generation should be calculated. One method, which many different stakeholders have expressed a desire for, is a value-based credit. This interest in value-based compensation has led many states, utilities, and other stakeholders to conduct studies examining the value of solar or distributed generation in efforts to inform net metering successor discussions (see Figure 2). However, these studies utilize many different methodologies and result in a wide range of ultimate values.

The first phase of this project aims to review recently conducted studies on value of distributed generation. The results of this review have been outlined below.

Figure 2: State-Led DG Valuation Action (2015 – 2017)



Source: NC Clean Energy Technology Center, 50 States of Solar Q1 2015 - Q3 2017

Existing Studies

One of the project partners, the NC Clean Energy Technology Center (NCCETC), has been compiling studies commissioned by either state regulatory bodies or utilities on value of distributed generation as part of its *50 States of Solar* quarterly report series. This database was first scanned to identify a short list of studies to be further reviewed for this project. Table 1 shows the full list of studies considered, as well as the cost/benefit components considered within each study. A list of studies is also provided in Appendix I.

Many states, utilities, advocacy organizations, and others have conducted these studies in order to examine the value of distributed generation, or solar specifically. The results of these studies vary dramatically, as Figure 3 shows.

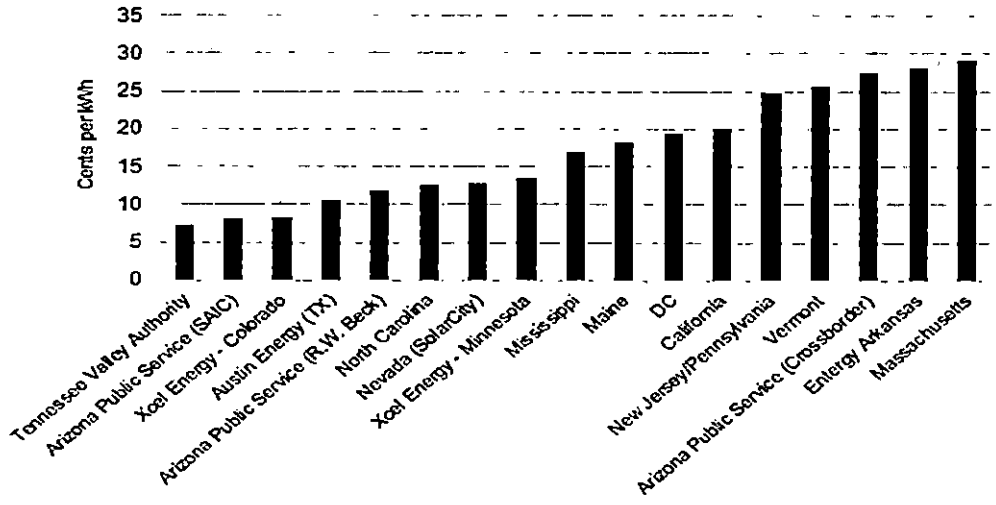
There are multiple reasons for this variation. The first is due to the utility's generation mix and infrastructure. As avoided energy and capacity costs are typically tied to the marginal generation unit, the particular unit that is on the margin will greatly impact the ultimate value. Furthermore, the utility's existing transmission and distribution network will affect the value of transmission and distribution expenditures avoided by distributed solar.

Table 1: Cost and Benefit Components Included in Recent Studies

		Costs		Benefits									
Year	Study	Integration Cost	Admin. Cost	Avoided Energy	Avoided Gen. Capacity	Avoided Transmission	Avoided Distribution	System/Line Losses	Ancillary Services	Risk/Price Hedging	Market Price Suppression	Env. Benefits	Other
2006	Austin Energy (CPR)			■	■	■							
2009	Arizona Public Service (R.W. Beck)			■	■	■							
2012	Michigan (NREL)			■	■	■							■
2012	New Jersey/Pennsylvania (CPR)			■	■	■							■
2013	CPS Energy			■	■	■							
2013	Arizona Public Service (SAIC)			■	■	■							
2013	Xcel Energy – CO (CPR)			■	■	■							
2013	Arizona Public Service (Crossborder)			■	■	■							
2013	North Carolina (Crossborder)			■	■	■							
2013	Austin Energy (CPR)			■	■	■							
2014	Utah (CPR)			■	■	■							
2014	Xcel Energy – MN (CPR)			■	■	■							
2014	Nevada (E3)			■	■	■							
2014	Mississippi (Synapse)			■	■	■							
2014	Vermont (Public Service Dept.)			■	■	■							
2015	Maine (CPR)			■	■	■							
2015	Massachusetts (Acadia Center)			■	■	■							
2015	Louisiana (Acadian Consulting)			■	■	■							■
2015	Tennessee Valley Authority (EPRI)			■	■	■							
2015	South Carolina (E3)			■	■	■							
2016	Arizona Public Service (Crossborder)			■	■	■							■
2016	Nevada (SolarCity)			■	■	■							
2016	Nevada (E3)			■	■	■							
2017	Georgia Power (Georgia Power)			■	■	■							
2017	District of Columbia (Synapse)			■	■	■							
2017	Oregon (PUC)			■	■	■							■
2017	Entergy Arkansas (Crossborder)			■	■	■							■

Variation across studies also results from the difference in solar penetration from location to location. Jurisdictions with high levels of distributed solar on the system may see diminished benefits from additional solar capacity, while jurisdictions with very little distributed solar are more likely to realize larger benefits, at least initially.

Figure 3: Value of DG Study Results



Finally, a significant reason for variation across studies is due to the different set of cost and benefit components included within each study. While some studies are narrower in focus, only including avoided energy and generation capacity for example, others are more expansive, including ancillary services and environmental benefits. Furthermore, for each cost or benefit component, there exists a variety of methodologies to calculate its quantitative value.

Cost-Benefit Methodologies

The first study reviewed was a meta-study conducted by the Rocky Mountain Institute (RMI) in 2013 [1]. This study provides a broad summary of the 16 benefit/cost studies for Distributed PV (DPV) systems conducted by utilities, national laboratories, and other organizations between 2005 and 2013. The study lists the following cost/benefit categories/components:

- Category 1: Energy: This includes avoided energy and avoided system losses.
- Category 2: Capacity: This includes avoided generation capacity, T&D Capacity, and DPV installed capacity.
- Category 3: Grid support services: also known as ancillary services and includes operating reserves, voltage control, and frequency regulation.
- Category 4: Financial Risk: Estimates the potential for DPV to provide a "hedge" against price volatility, and thus reducing risk exposure to utilities and customers.
- Category 5: Security Risk: Potential of DPV to reduce outages and also potential for customers to have back-up power capability.
- Category 6: Environmental: Potential to reducing carbon emissions.

- Category 7: Social: Social value of DPV based on its contribution to economic growth.

The report indicates that there is significant deviation about how these components are quantified. A more detailed summary of this report is provided in Appendix II.

The project team then selected five more recent DG valuation studies for a more in-depth review. These studies were selected to represent examples of studies conducted in other southeastern states, studies with varying cost and benefit components included, and studies conducted by different authors (frequently, outside consultants will be hired to conduct the study analysis, and many existing studies utilize the same consultancies). The studies reviewed are shown below.

Study	Description
Georgia Power [2] (2016, authored by utility)	This study was conducted as part of the utility's integrated resource planning process. The study considers technology and supporting infrastructure as they exist presently. The purpose of the report is to define an impact related to distributed energy resources as a cost and/or benefit and to quantify the same.
Minnesota [3] (2014, authored by consultant on behalf of state govt.)	This study was conducted by Clean Power Research on behalf of the Minnesota Department of Commerce. The state developed a methodology to calculate the value solar with an eventual aim to replace the existing net metering policy with a value of solar rate structure. If known and measurable evidence of other costs and/or benefits existed, then it was decided to incorporate them into the methodology.
Mississippi [4] (2014, authored by consultant on behalf of state govt.)	This study was conducted by Synapse Energy Economics on behalf of the Mississippi Public Service Commission as part of an investigation into the creation of net metering rules for the state.
Tennessee Valley Authority [5] (2015, authored by EPRI/stakeholder group)	This study was led by the EPRI, with a stakeholder group developing the cost-benefit categories. The purpose of the study was to select cost/benefit categories and develop a firm analytical basis for calculating each of these categories. The study was limited to rooftop solar and aimed to create a transparent, fair, adaptable, and versatile methodology. The final calculation did not include societal values that were identified and set aside for potential future inclusion.
Vermont [6] (2014, authored by state govt.)	This study was conducted by the Vermont Public Service Department. Act 99, enacted in 2014, direct the Department to conduct an evaluation of net metering in the state.

Each of these studies has been reviewed in detail to determine the methods used to quantify the cost/benefit components the study considered. Table I shows the main components considered in these studies. Below is a summary of the methodologies adopted in these studies for each component. A more detailed summary for each study reviewed is provided in Appendix III.

Cost 1: Solar Integration Costs

The majority of studies include the costs associated with integrating distributed solar in their cost-benefit calculations. The table below summarizes the methods used by the five studies examined.

Study	Methodology
Georgia Power	Distribution operating costs is given a placeholder value, as the utility has not developed a methodology to calculate the expected costs associated with significant penetration of renewable resources. A point was made that interconnection costs are directly assignable to the generator at the time of implementation, and should therefore not be included in the methodology.
Minnesota	Included in the cost-benefit stack, but a methodology has not yet been developed.
Mississippi	Solar integration costs were ignored. Synapse concluded that grid integration costs increase as penetration level increases. They found very little evidence that significant costs are incurred by grid operators or distribution companies since penetration levels are low in Mississippi.
Tennessee Valley Authority	Not included in study, although the authors noted that the transmission capacity value may be revised to include integration costs.
Vermont	Notably, as the location out of the five examined with the most net-metered capacity, this component is not included in the study.

Cost 2: Administrative Costs

A smaller number of studies include administrative costs associated with distributed solar (such as administering a net metering program) in their calculations. The table below summarizes the methods used by the three studies addressing administrative costs.

Study	Methodology
Georgia Power	A placeholder value is provided in the report, but a methodology has not been determined.
Mississippi	The authors collected cost data for energy efficiency programs from many states. The authors estimated that an average utility spends between 6-9% of energy efficiency program expenses on administrative costs (average is 7.5%). Energy efficiency programs in Mississippi cost approximately $12 million, and 7.5% of $12 million is $0.9 million.
Vermont	Administrative costs are assumed to be the same values as reported in "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012," which include two types of costs: procedural and billing.

Benefit 1: Avoided Energy

Solar PV generation avoids the need for a certain amount of energy from the marginal generators (typically natural gas). Avoided energy values often factor in fuel price forecasts, power plant efficiencies, and variable operating and maintenance (O&M) costs. The table below summarizes the methods used by the five studies examined.

Study	Methodology
Georgia Power	Calculated as the weighted average of the energy produced by solar PV per hour and the system avoided cost of energy for that period. This value depends on the resource displaced, its incremental heat rate, variable O&M, fuel handling costs, and losses.
Minnesota	A virtual solar heat rate is computed based on the heat rate vs energy production of each generator. This weighted heat rate is then multiplied by the burnertip fuel unit price to give the value of avoided fuel costs.
Mississippi	Avoided energy costs are estimated by multiplying the variable operating and fuel costs of the marginal resource by the projected MWh of solar generation modeled in each year.
Tennessee Valley Authority	The Resource Planning Process is run with and without PV using an hourly time-step. The value depends upon the avoided resource and the fuel price.
Vermont	Avoided energy was calculated on an hourly basis by multiplying the production of real Vermont generators by the hourly price set in the ISO-NE market. These calculations indicated that fixed solar PV had a weighted average avoided energy price 9% lower than the annual ISO-NE average spot market price.

Benefit 2: Avoided Generation Capacity

Distributed generation may defer or obviate the need for new investments in generation capacity. In most locations, natural gas combustion turbines are the marginal units, and avoided generation capacity value is based on the cost of these units. The table below summarizes the methods used by the five studies examined.

Study	Methodology
Georgia Power	Calculated as the product of capacity value and capacity equivalence. Capacity equivalence is similar to Effective Load Carrying Capacity (ELCC), wherein only some fraction of the installed solar PV is considered to reduce capacity needs from the grid. Also includes Generation Remix Costs (GRC), which are identified as being either a cost or a benefit. GRC includes two components, (1) the capital cost and (2) the production cost. The GRC formula can be found in Appendix III.

	Support capacity costs are calculated as the difference between the capital (or production) cost in the base case and the capital (or production) cost with PV in the system (generation remix case).
Minnesota	The solar-weighted capacity cost is based on the installed capital cost of a peaking combustion turbine and the installed capital cost of a combined cycle gas turbine, interpolated based on heat rate.
Mississippi	The authors calculated the amount of installed solar capacity every year (assumed 88 MW for analysis) and calculated the number of MW that contribute to reduction in peak load by using an Effective Load Carrying Capability (ELCC) of 58%. Thus, capacity contribution will be 58% of 88MW, which is 51 MW. The authors multiplied this capacity contribution by the capacity value in each year and divided this by total solar generation in that year to yield a $/MWh value.
Tennessee Valley Authority	The Resource Planning Process is run with and without PV for a period of 20 years. A multiplier - Net Dependable Capacity (NDC) - is used for capacity-related benefits and reflects the proportion of PV capacity that offsets conventional generation capacity. The system peak and the related solar output at that time are compared to calculate NDC. A 50% NDC is used to calculate avoided generation capacity.
Vermont	The study examined the timing of relevant peaks: ISO-NE's peak for capacity costs, Vermont summer peaks for in-state transmission costs, monthly Vermont peaks for Regional Network Service (RNS) costs and utility specific peak hours for distribution costs. The ability of variable generators to help avoid ISO-NE capacity costs depends on the level of generation during summer hours when ISO-NE's system demand peaks.

Benefit 3: Avoided Transmission and Distribution Capacity

Distributed generation may relieve congestion on the transmission and distribution (T&D) system, deferring or obviating the need for new investments. More granular analyses may develop locational values for avoided T&D. The table below summarizes the methods used by the five studies examined.

Study	**Methodology**
Georgia Power	A single transmission line outage contingency analysis is performed. The analysis is performed with and without PV to study the impact (and cost or benefit) of PV on the grid. Georgia Power only includes avoided transmission, and does not include avoided distribution investment in its analysis.
Minnesota	Calculated in a similar way as avoided generation capacity. No degradation in capacity is considered. It is based on the utility's 5-year average MISO OATT Schedule 9 charge in start year U.S. dollars.
Mississippi	Authors used their in-house database to calculate avoided T&D costs calculated for DG and energy efficiency programs to provide a rough estimate.
Tennessee Valley	The costs and benefits are evaluated by considering the system peak, NDC, PV profile, and avoided costs; a simplified calculation with the point to point service rate and monthly peak factors was

Authority	ultimately used.
Vermont	Avoided Regional Transmission Costs: The values quantified for these costs are based on the ISO-NE forecast for the next three years' worth of Regional Network Service charges and escalated based on historical increases in the handy-Whitman Index of public utility construction costs. Avoided In-State Transmission and Distribution Costs: Burlington Electric Department forecasts show that there are no load growth related infrastructure investments planned for next 20 years, hence these costs have been excluded. In-state transmission and distribution upgrades deferred due to load reduction are calculated considering the critical value of how much generation the grid can rely on during peak times. Reliability peak coincidence values were calculated separately from economic peak coincidence values.

Benefit 4: Avoided System and Line Losses

As distributed generation is located nearer to end-use consumers, it may reduce system and line losses associated with transmitting power from centralized generators long distances to reach end users. System losses are sometimes included within avoided energy and avoided T&D capacity. The table below summarizes the methods used by the five studies examined.

Study	Methodology
Georgia Power	As the load is reduced or displaced in the model by DG, the impact of the load reduction and related transmission system losses is inherently included in the analysis of any change in timing of transmission investment. The demand component is recognized as a benefit that is already included in the avoided transmission capacity value. The reduced distribution energy loss is calculated by applying an 8760-hour distribution loss profile to the system avoided energy costs. The benefit of the reduced distribution energy losses is incorporated into the avoided energy cost calculation.
Minnesota	Calculated on a marginal basis as the difference in losses between the cases with and without marginal PV resource. A loss saving factor is calculated, based on the avoided energy with and without losses.
Mississippi	Synapse estimates avoided system losses using a weighted average line loss during each daylight hour. Calculated by weighing daylight line losses of each T&D system in proportion to the load each system serves. Avoided system losses were calculated as the product of weighted average system losses and projected generation from solar in each year times the avoided energy cost in the same year.
Tennessee Valley Authority	All components except environmental market value are multiplied by an average loss savings value. A 1 MW AC solar PV case was used to model average marginal loss savings.
Vermont	Included as part of the methodologies for avoided energy and avoided generation capacity.

Benefit 5: Ancillary Services

Solar PV can sometimes reduce the need for certain ancillary services, including operating reserves, reactive supply, voltage control, frequency regulation, energy imbalance, and scheduling. Some studies may quantify the value of multiple ancillary services or only one. The table below summarizes the methods used by the three studies addressing ancillary services.

Study	Methodology
Georgia Power	Includes ancillary services (reactive supply, voltage control, and regulation) as a *cost*, rather than a benefit. The regulating reserve requirement is calculated and consists of two components: (1) regulating reserve reliability impact and (2) forecast error reliability impact.
Minnesota	Avoided voltage control cost is included in the cost-benefit stack, but a methodology has not yet been determined.
Tennessee Valley Authority	Ancillary services value was acknowledged, but not included in calculation. Authors determined that further study and data is needed.

Benefit 6: Price Hedging and Risk Reduction

Solar PV offers price certainty, while the cost of energy from fossil fuel fired generators depends upon variable fuel prices. Price hedging value is typically based on the price of natural gas futures and estimates of future natural gas costs. The table below summarizes the methods used by the three studies addressing price hedging.

Study	Methodology
Georgia Power	Georgia Power addressed fuel hedging in its study, but recommended not including this in the cost-benefit framework, stating that it does not believe renewable resources provide this benefit.
Minnesota	The avoided fuel cost value includes the avoided cost of price volatility risk.
Mississippi	The risk reduction benefit estimation was calculated by applying an adder (adjustment factor) to the avoided costs rather than attempting a technical analysis. Current optimal practice supports a 10% adder to avoided costs of renewables like solar.

Benefit 7: Market Price Suppression

Solar PV can suppress wholesale market prices by reducing customer demand for energy or by being directly bid into wholesale markets (either larger PV facilities or smaller aggregated facilities). This can cause the marginal generator to be a lower-cost unit, reducing electricity costs for all customers. The table below summarizes the methods used by the two studies addressing market price suppression.

Study	Methodology
Minnesota	Market price reduction is addressed in the study, but was not included in the final value of solar methodology.
Vermont	Approximated this using the analysis based on the 2013 Avoided Energy supply cost study calculations of the demand reduction induced price effect for Vermont.

Benefit 8: Environmental Compliance and Benefits

Many DG valuation studies include a value for environmental benefits or reduced environmental compliance costs. These values include reduced carbon emissions, criteria air pollutants, water use, land use, as well as avoided or costs of complying with renewable portfolio standard policies and other clean energy or environmental regulations.[1] Table below summarizes the methods used.

Study	Methodology
Georgia Power	Avoided cost of complying with existing environmental regulations is included as part of avoided energy costs. Other environmental benefits and compliance with potential future regulations are not included.
Minnesota	Environmental costs are based on existing Minnesota and EPA externality costs. CO_2 and non-CO_2 natural gas emissions factors (lb per MM BTU of natural gas) are taken from the EPA. The costs are adjusted for inflation (converted to current dollars), converted to dollars per short ton, and then converted to cost per unit fuel consumption using the assumed values. The externality costs are taken as the midpoint of the low and high values for the urban scenario, adjusted to current dollars, and converted to a fuel-based value.
Mississippi	The analysis uses the mid case of the authors' avoided environmental compliance estimation. It is forecasted that a carbon price begins in 2020 at $15 per ton and increases to $60 per ton in 2040.
Tennessee Valley Authority	Compliance Value: Environmental compliance value is based on the carbon intensity of the generation assets deferred. A CO_2 compliance cost curve beginning in 2022 is assumed. Market Value: This is the value of a renewable energy credit (REC). A $1/MWh value (based on national voluntary REC market prices) is applied with a 1.9% escalation rate, consistent with TVA's integrated resource planning process. A placeholder for other environmental benefits is also included.
Vermont	Renewable Energy Credit Value: A fixed value of $30/MWh is assumed for potential future regulatory value of REC retirement. (At the time of this study, Vermont did not have a mandatory renewable portfolio standard (RPS). In 2015, the Vermont legislature adopted a binding RPS of 75% by 2032.) Environmental Compliance Value: Analysis was done for non-participating ratepayers both with

[1] Rocky Mountain Institute, A Review of Solar PV Benefit and Cost Studies, September 2013.

	and without an externalized cost of greenhouse gas emissions. The authors assumed a value of $100/metric ton of CO_2.

Benefit 9: Other Benefits

A handful of studies included other societal benefits, such as local economic development (3 studies examined) and enhanced security (2 studies examined). Several studies acknowledged these additional benefits, but did not attempt to quantify them.

Sensitivity Analysis

Many DG valuation studies include various sensitivity analyses in order to display the range of values produced by adjusting assumptions and methods. For example, several studies calculate one value based on the "direct" benefits of solar, and a separate value including societal benefits. Other studies vary the time horizon over which the analysis is conducted, assumptions about future fuel prices, or the amount of installed solar capacity.

Study	Sensitivity Analyses
Georgia Power	No sensitivity analyses were conducted.
Minnesota	No sensitivity analyses were conducted, likely because a state methodology had been adopted.
Mississippi	Sensitivity analyses are conducted for low, mid and high fuel price scenarios and capacity value scenarios. Synapse utilized the 25th and 75th percentiles of its T&D cost database to produce T&D cost sensitivities. Low, mid, and high cases were also examined for CO_2 prices. Two combined sensitivities were also modeled, which included the assumptions that would produce the lowest and highest benefits for solar.
Tennessee Valley Authority	Illustrative values are provided for several of the placeholder categories that are not included in the DG-IV methodology, although no formal sensitivity analysis was conducted.
Vermont	The costs and benefits for six different types of solar and wind systems are calculated, although no sensitivity analyses for these systems are conducted.

Of the five studies examined, the Mississippi study is the only study including formal sensitivity analyses. Low, mid, and high cases are modeled for fuel prices, capacity value, T&D costs, and CO_2 price, as well as two combined sensitivities that reflect the assumptions yielding the lowest and highest benefits to solar.

Conclusion

Existing studies examining the value of DER display great variation in cost-benefit categories and methodologies, producing a large spread in results. Core categories included in nearly every study the

team examined were avoided energy, avoided generation capacity, avoided transmission and distribution capacity, and system/line losses. Most studies also included solar integration costs and at least some environmental benefits. Despite these commonalities, each study utilizes different assumptions and methods in calculating these components.

Several studies utilized a stakeholder or state-led process to develop the categories to be included in the study, as this can greatly influence the final results. Some states, such as Oregon and Rhode Island, have developed official cost-benefit frameworks through stakeholder processes before attaching any quantitative values to categories. Studies conducted by singular, non-government parties (solar advocacy organizations, utilities, etc.) are not to be discredited, but should be read with funder and author in mind.

Many studies include various sensitivity analyses to display multiple possibilities, varying both technical assumptions as well as which cost-benefit components are included (several studies produce results with and without a broader set of societal benefits). This approach makes available a large amount of data, helping to answer the question of whether DG provides each benefit, while leaving the question of whether DG should be compensated for each benefit to policymakers, utilities, and advocates.

Phase II of this project will evaluate the various methodologies utilized in existing DG valuation studies to develop a methodology for use in a North Carolina case study.

References

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Appendix I: Existing Value of Solar and Net Metering Cost-Benefit Studies

Date	Jurisdiction	Initiator	Author
Jan. 2009	Arizona Public Service	Arizona Public Service	R.W. Beck
Jan. 2012	Michigan	Public Service Commission	National Renewable Energy Laboratory
Nov. 2012	New Jersey, Pennsylvania	MDV SEIA, PA SEIA	Clean Power Research
Mar. 2013	CPS Energy (Texas)	Solar San Antonio	Clean Power Research, Solar San Antonio
May 2013	Arizona Public Service	Arizona Public Service	SAIC
May 2013	Xcel Energy (Colorado)	Xcel Energy	Xcel Energy
May 2013	Arizona Public Service	The Alliance for Solar Choice	Crossborder Energy
Oct. 2013	North Carolina*	NC Sustainable Energy Assn.	Crossborder Energy
Dec. 2013	Austin Energy (Texas)	Austin Energy	Clean Power Research
Jan. 2014	Rocky Mountain Power (Utah)	Utah Clean Energy	Clean Power Research
Apr. 2014	Xcel Energy (Minnesota)	Xcel Energy	Clean Power Research, Xcel Energy
Jul. 2014	Nevada*	Public Utilities Commission	E3
Sep. 2014	Mississippi	Public Service Commission	Synapse Energy Economics
Nov. 2014	Vermont*	Department of Public Service	Department of Public Service
Mar. 2015	Maine	Public Utilities Commission	Clean Power Research
Apr. 2015	Massachusetts	Acadia Center	Acadia Center
Sep. 2015	Louisiana*	Public Service Commission	Acadian Consulting
Oct. 2015	Tennessee Valley Authority	Tennessee Valley Authority	EPRI, stakeholder group
Dec. 2015	South Carolina*	Office of Regulatory Staff	E3
Feb. 2016	Arizona Public Service	The Alliance for Solar Choice	Crossborder Energy
May 2016	Nevada*	SolarCity, NRDC	SolarCity, NRDC
Aug. 2016	Nevada*	Legislative Committee on Energy	E3
Mar. 2017	Georgia Power	Georgia Power	Georgia Power
May 2017	District of Columbia	Office of the People's Counsel	Synapse Energy Economics
July 2017	Rhode Island	Public Utilities Commission	Public Utilities Commission, stakeholders
Sep. 2017	Oregon	Public Utilities Commission	Public Utilities Commission, stakeholders
Sep. 2017	Entergy Arkansas*	Sierra Club	Crossborder Energy

* Net metering cost-benefit study

Appendix II: Summary of Rocky Mountain Institute Report: *A Review of Solar PV Benefit and Cost Studies (2013)*

The aim of this report was to compare various methodologies for evaluating different value streams of distributed solar photovoltaics (DPV). The report is based on a review of 16 DPV benefit-cost studies completed by utilities, national laboratories, and other organizations between 2005 and 2013.

The report points out the framework developed in the California Standard Practice Manual, which establishes the general standard for evaluating the costs and benefits of energy efficiency among stakeholders was adopted. This framework describes the followings costs:

1. **Participant Cost:** Cost that is incurred by the participants in order to generate energy through DERs. (Equipment and installation costs, etc.)
2. **Rate Impact:** The change in rates for non-participating customers due to cost shifting/cross subsidization that occurs as a result of DERs on the grid.
3. **Utility Cost:** The cost that the utility incurs to support the smooth function of DERs on the grid, while maintaining reliability and quality of service.
4. **Total Resource Cost:** The total cost of operating and supporting DERs on the grid. This includes the costs borne by participants, other customers, and the utility.
5. **Societal and Environmental Cost:** The cost avoided in the form of environmental compliance, regulation etc., as well as, the additional revenue generated from economic activities related to DER.

As illustrated in Figure A1, the report identifies the following benefit & cost categories:

1. **Energy** value is created when DPV generates energy (kWh) that displaces the need to produce energy from another resource. There are two components of energy value: the amount of energy that would have been generated equal to the DPV generation, and the additional energy that would have been generated, but is lost in delivery due to inherent inefficiencies in the transmission and distribution system. The second component is system losses.
    - This value will depend on the resource on the margin at each time interval
    - Depends on the market structure, fuel price, plant efficiency, and Variable O&M costs

2. **Capacity**

    2.1: Generation Capacity value is the amount of central generation capacity that can be deferred or avoided due to the installation of DPV. Key drivers of this value include: (1) DPV's effective capacity and (2) system capacity needs. Deferred value depends on the effective load carrying capacity (ELCC), which depends on the system peak and the capacity of DPV during the same period.

    2.2 Transmission and Distribution (T&D) Capacity value is a measure of the net change in T&D infrastructure as a result of the addition of DPV. Benefits occur when DPV is able to meet rising demand locally, relieving capacity constraints upstream and deferring or avoiding T&D upgrades. Costs are incurred when additional T&D investments are necessary to support the

addition of DPV, which could occur when the amount of solar energy exceeds the demand in the local area and increases needed line capacity. This value depends on ELCC/peak load reduction.

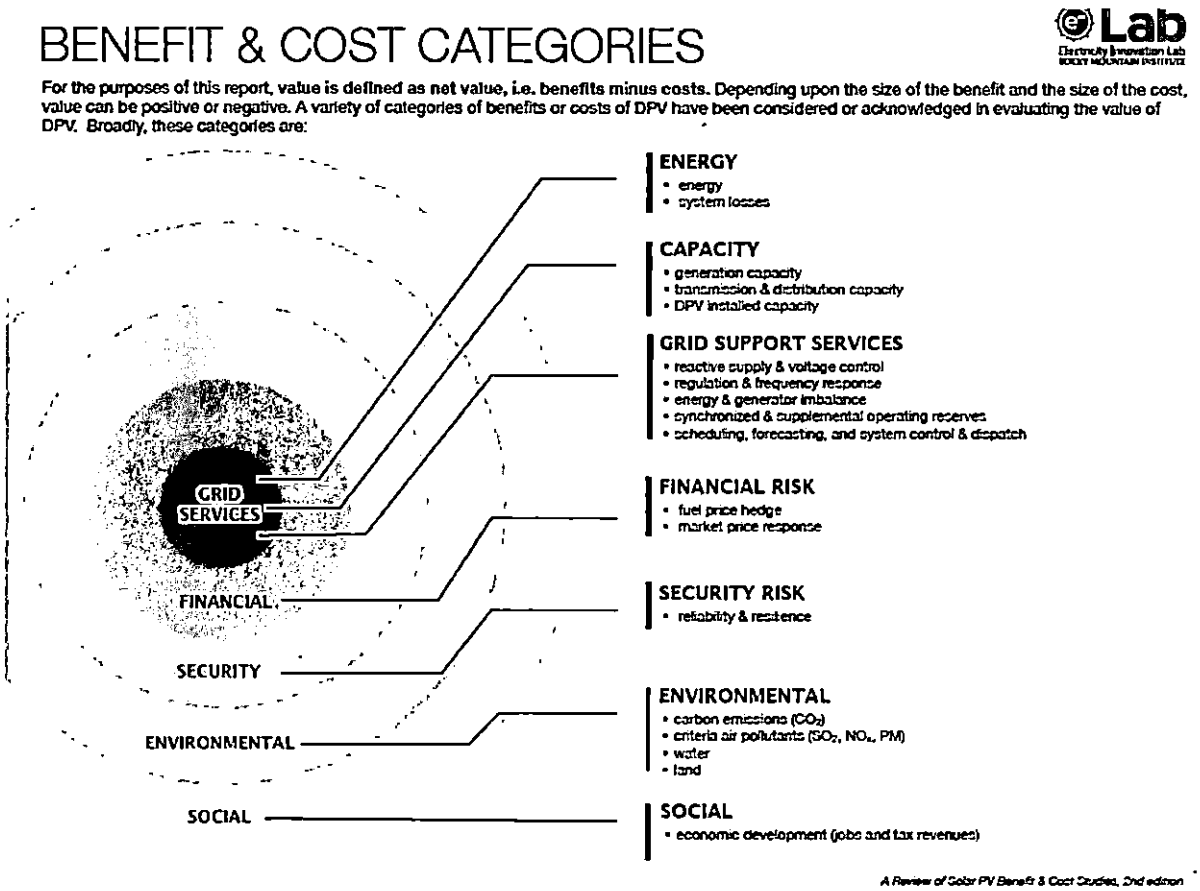

Figure A1: RMI Benefit and Cost Categories

3. **Grid Support Services,** also commonly referred to as ancillary services in wholesale energy markets, are required to enable the reliable operation of interconnected electric grid systems. These services include operating reserves; reactive supply and voltage control; frequency regulation; energy imbalance; and scheduling. The value DPV could provide comes by reducing load and required reserves or the ancillary services that DPV could provide when coupled with other technologies. This value depends on market structure and the type of services that DPV can provide.

4. **Financial Risk:** DPV produces roughly constant-cost power compared to fossil fuel generation, which is tied to potentially volatile fuel prices. DPV can provide a "hedge" against price volatility, reducing risk exposure to utilities and customers. The addition of DPV, especially at higher penetrations, can affect the market price of electricity in a particular market or service territory. These market price effects span energy and capacity values in the short term and long term, all of which are interrelated. This value depends on resource being displaced.

5. **Security Risk:** The grid security value that DPV could provide is attributable to three primary factors, the last of which would require coupling DPV with other technologies to achieve the benefit:
    - The potential to reduce outages by reducing congestion along the T&D network. Power outages and rolling blackouts are more likely when demand is high, and the T&D system is stressed.
    - The ability to reduce large-scale outages by increasing the diversity of the electricity system's generation portfolio with smaller generators that are geographically dispersed.
    - The benefit to customers to provide back-up power sources available during outages through the combination of PV, control technologies, inverters and storage.

6. **Environmental:** The benefits of reducing carbon emissions and other pollutants include (1) reducing future compliance costs, carbon taxes, or other fees and (2) mitigating the heath and ecosystem damages potentially caused by these pollutants, as well as climate change. The cost related to a reduction in the use of land, water, and other such resources can also be considered.

7. **Social:** The assumed social value from DPV is based on any job and economic growth benefits that DPV brings to the economy, including jobs and increased tax revenue. The value of economic development depends on the number of jobs created or displaced, as measured by a job multiplier, as well as the value of each job, as measured by average salary and/or tax revenue.

One of the main conclusions of the report is that there is a significant range of estimated values across studies. Figure A2 illustrates these variations. The authors point out that these variations are driven primarily by differences in local context, input assumptions, and methodological approaches:

- Local context: Electricity system characteristics—generation mix, demand projections, investment plans, market structures vary across utilities, states, and regions.
- Input assumptions: Input assumptions—natural gas price forecasts, solar power production, power plant heat rates can vary widely.
- Methodologies: Methodological differences that most significantly affect results include (1) resolution of analysis and granularity of data, (2) assumed cost and benefit categories and stakeholder perspectives considered, and (3) approaches to calculating individual values.

Another issue highlighted by this report is the cross subsidization that can occur between DER and non-DER customers, especially through net metering. DER customers are charged only for their net usage, which may not their fixed costs for use of the grid. In the short term, utility costs are fixed, and as a result, the reduced revenue collected from DER customers must be recovered from non-DER customers.

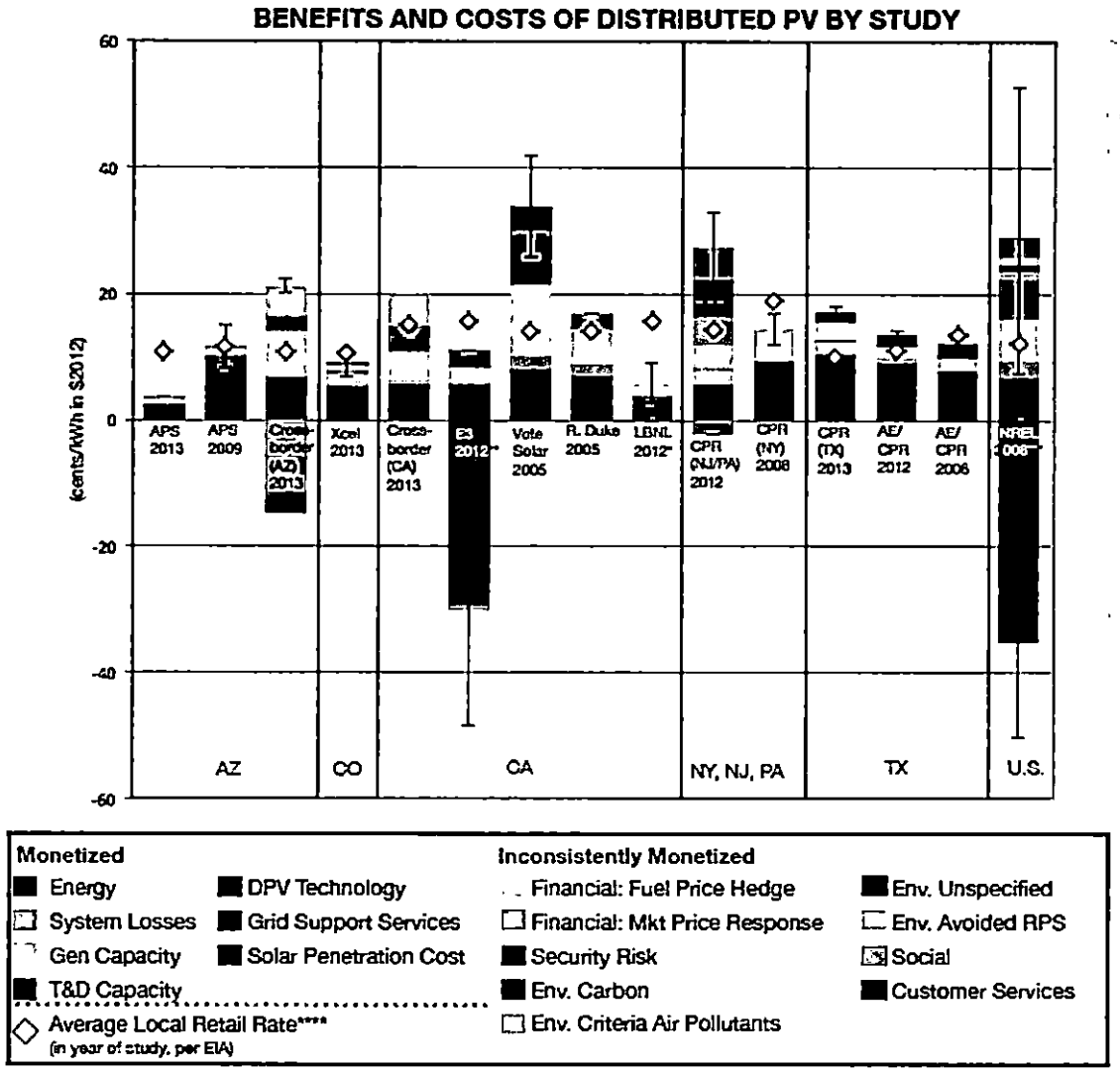

Figure A2: Variation of DPV Values in Studies Reviewed By RMI

Appendix III.A: Summary of Study: *A Framework for Determining the Costs and Benefits of Renewable Resources in Georgia (Georgia Power, 2017)*

As part of Georgia Power's 2016 Integrated Resource Planning proceeding, the utility developed a framework for determining the costs and benefits of renewable resources. The study considers technology and supporting infrastructure as they exist presently and examines both utility-scale and distributed generation. The purpose of the report is to define each impact related to renewables as a cost and/or benefit and to quantify each. The quantitative values ultimately arrived at are redacted.

The value streams identified in the report are as follows:

1. Avoided Fuel and Power cost
2. Avoided Generation VO&M Cost
3. Avoided Environmental Compliance Cost
4. Deferred Generation Capacity Cost
5. Deferred Generation FO&M Cost
6. Reduced Transmission Energy Losses
7. Reduced Transmission Capacity Losses
8. Deferred Transmission Investment
9. Reduced Distribution Energy Losses
10. Distribution Operations Cost
11. Generation Remix Cost

The report further expounded on the following items:

1. **Avoided Energy Costs:** Calculated as the weighted average of the energy produced by solar PV per hour and the system avoided cost of energy for that period. This value depends on the resource displaced, its incremental heat rate, variable O&M, fuel handling costs, and losses.

2. **Deferred Capacity Costs:** Calculated as the product of capacity value and capacity equivalence. Capacity equivalence is similar to Effective load carrying capacity (ELCC), wherein only some fraction of the installed solar PV is considered to reduce capacity needs from the grid.

3. **Deferred Transmission Investment Costs:** Calculated in a similar manner as avoided generation capacity; the planning horizon considered is 20 years. A single transmission line outage contingency analysis is performed using MUST (Managing and Utilizing System Transmission) power flow analysis tool. The analysis is performed with and without PV to study the impact (and cost or benefit) of PV on the grid. Georgia Power only includes avoided transmission, and does not include avoided distribution investment in its analysis.

4. **Reduced Transmission Losses:** The demand component of transmission losses represents the reduction in demand (MW) on the transmission system, resulting from a reduction in transmission system losses due to the renewable generation. As the load is reduced or displaced in the model by DG, the impact of the load reduction and related transmission system losses is inherently included in the analysis of any change in timing of transmission investment. The demand component is recognized as a benefit that is already included in the avoided transmission capacity value.

5. **Reduced Distribution Energy Losses:** The reduced distribution energy loss due to the addition of DG is calculated by applying an 8760-hour (8784 for leap year) distribution loss profile to the system avoided energy costs. Alternatively, the DG profile can be grossed up by the amount of distribution losses. In this case, the benefit of the reduced distribution energy losses is incorporated into the avoided energy cost calculation.

6. **Generation Remix Costs:** This has two components: capital cost and production cost.
   a. The capital component is calculated as follows:

$$GRC = (SMC_{remix} - SMC_{base}) - DGCC$$

   GRC = Generation Remix Capital Cost, SMC_{base} = Capital cost of the future build-out of the System Mix base case, SMC_{remix} = Capital cost of the future build-out of the System Mix case with the renewable resource, *DGCC* = Deferred Generation Capacity Costs associated with the renewable resource.

   b. The production cost/energy component is calculated as follows:

$$GRP = (SPC_{remix} - SPC_{base}) - AEC.$$

   GRP = Generation Remix Production Cost, SPC_{base} = System production cost of the base case, SPC_{remix} = System production cost of the case with the renewable resource and modified expansion plan, and *AEC* = Avoided Energy Cost associated with the renewable resource

7. **Support Capacity Costs:** It is calculated in the same way as generation remix costs, it also has two components related to capital and production. It is calculated as difference between the capital (or production) cost in the base case and the capital (or production) cost with PV in the system (generation remix case).

8. **Regulating Reserve Requirement:** Consists of the regulating reserves required when solar PV is installed on the grid. It has two components: (1) the regulating reserve reliability impact, which depends on the expected reserve requirement as a percent of nominal DER capacity (as it is scaled by the capacity worth factor) and (2) the forecast error reliability impact, which depends on the expected DER forecast error as a percent of nominal DER capacity.

The report also highlights the need to study peak shifting and ramping issues as solar PV production increases. Other costs, such as Bottom Out Costs, Starts-Based Maintenance Costs, Planning Reserve Margin Costs, Distribution Operating Costs, and Program and Administrative Costs were given placeholder values, as Georgia Power has not developed a methodology to calculate the expected costs associated with significant penetrations of renewable resources.

Appendix III.B: Summary of Study: *Minnesota Value of Solar: Methodology (Clean Power Research, 2014)*

Clean Power Research, on behalf of the Minnesota Department of Commerce, developed a methodology to determine the value of solar (VOS) in Minnesota. The aim was to replace the existing net metering program with a VOS rate structure. While the state developed an official methodology, no utility has yet adopted a VOS compensation structure for distributed solar customers. The categories identified and evaluated were as follows:

1. Avoided Fuel Cost
2. Avoided Plant Operation and Maintenance – Fixed
3. Avoided Plant Operation and Maintenance – Variable
4. Avoided Generation Capacity Cost
5. Avoided Reserve Capacity Cost
6. Avoided Transmission Capacity Cost
7. Avoided Distribution Capacity Cost
8. Avoided Environmental Cost
9. Placeholder for Avoided Voltage Control Costs and Solar Integration Costs

The PV output was estimated either through direct metering or simulation models with actual/expected parameters. The PV was treated as a marginal resource. If known and measurable evidence of other costs and/or benefits existed, then it was decided to incorporate them into the methodology. The end result would be a $/kWh rate. The main components are estimated as follows:

1. **Avoided Energy** is the sum of the total fleet production on a yearly basis.

2. **Avoided Losses** are calculated on marginal bases as the difference in losses between the case with and without marginal PV resource. T&D losses are considered separately, while No Load losses are not included. A loss saving factor is calculated, based on the avoided energy with and without losses. The same is used later to derive other quantities.

3. **Avoided Fuel Costs**: The fuel that would have been required to produce the energy that has been subsequently displaced by PV. It is based on the NYMEX Futures Market. A virtual solar heat rate is computed based on the Heat rate vs energy production of each generator. This weighted heat rate is then multiplied by the burnertip fuel unit price which give the value of avoided fuel costs.

4. **Avoided O&M (Fixed and Variable):** Avoided O&M is the O&M cost (total) multiplied by the ratio of PV capacity to utility capacity. They are avoided only when the resource requiring fixed O&M is avoided. Per-unit PV production is considered with annual degradation taken into account.

5. **Avoided Generation Capacity**: The solar-weighted capacity cost is based on the installed capital cost of a peaking combustion turbine and the installed capital cost of a combined cycle gas turbine, interpolated based on heat rate.

   The following formula quantifies it:

$$Cost = Cost_{CCGT} + (HeatRate_{PV} - HeatRate_{CCGT}) \times \frac{Cost_{CT} - Cost_{CCGT}}{HeatRate_{CT} - HeatRate_{CCGT}}$$

   The avoided reserve margin is calculated similarly, multiplying utility costs by the reserve margin.

6. **Avoided Reserve Capacity Costs:** This is identical to the generation capacity cost calculation, except utility costs are multiplied by the reserve capacity margin.

7. **Avoided Transmission Capacity**: It is calculated on a similar way to avoided generation costs. No degradation is capacity is considered. It is based on the utility's 5-year average MISO OATT Schedule 9 charge in Start Year USD

8. **Avoided Distribution Capacity Costs:**
   a. **System-Wide Avoided Costs:** These are calculated using utility-wide costs and lead to a VOS rate that is "averaged" and applicable to all solar customers. The costs and growth rate are determined using actual data from each of the last 10 years. They must be taken over the same time period because the historical investments must be tied to the growth that led to the investments.

   The amount of new distribution capacity is calculated based on the growth rate, and this is multiplied by the cost per kW to get the cost for the year. The total discounted cost is calculated and amortized over the 25 years. PV is assumed to be installed in sufficient capacity to allow this investment stream to be deferred for one year. Utility costs are calculated using the difference between the amortized costs of the conventional plan and the amortized cost of the deferred plan.

   b. **Location-Specific Avoided Costs:** These are calculated using location-specific costs, growth rates, etc., and lead to location-specific VOS rates.

9. **Avoided Environmental Costs:** Environmental costs are included as a required component and are based on existing Minnesota and EPA externality costs. CO2 and non-CO2 natural gas emissions factors (lb per MM BTU of natural gas) are taken from the EPA. The costs are adjusted for inflation (converted to current dollars), converted to dollars per short ton, and then converted to cost per unit fuel consumption using the assumed values. The externality costs are taken as the midpoint of the low and high values for the urban scenario, adjusted to current dollars, and converted to a fuel-based value

Proposed Formula

To calculate a utility's Value of Solar rate, a set of avoided cost components are each multiplied by a load match factor (if one is appropriate) and a loss savings factor. Adding the results of these separate component calculations produces the utility's total Value of Solar rate.

$$\sum Avoided\ Cost_{component} \times Load\ Match\ Factor_{component} \times (1 + Loss\ Savings\ Factor_{component}) = Value\ of\ Solar$$

The load match factor is 1 for energy related quantities, and it is the ELCC/PLR for demand/capacity related quantities. Figure A3 shows the value of each component calculated with this methodology. The final value of solar rate was $0.135 per kWh.

25 Year Levelized Value	Gross Starting Value ($/kWh)	× Load Match Factor (%)	× (1 + Loss Savings Factor (%)	) = Distributed PV Value ($/kWh)
Avoided Fuel Cost	$0.061		8%	$0.066
Avoided Plant O&M - Fixed	$0.003	40%	9%	$0.001
Avoided Plant O&M - Variable	$0.001		8%	$0.001
Avoided Gen Capacity Cost	$0.048	40%	9%	$0.021
Avoided Reserve Capacity Cost	$0.007	40%	9%	$0.003
Avoided Trans. Capacity Cost	$0.018	40%	9%	$0.008
Avoided Dist. Capacity Cost	$0.008	30%	5%	$0.003
Avoided Environmental Cost	$0.029		8%	$0.031
Avoided Voltage Control Cost				
Solar Integration Cost				
				$0.135

Figure A3: Minnesota Value of Solar Calculation by Component

Appendix III.C: Summary of Study: *Net Metering in Mississippi: Costs, Benefits, and Policy Considerations (Synapse Energy Economics, 2014)*

As part of a docket investigating the establishment of net metering and interconnection rules, the Mississippi Public Service Commission hired Synapse Energy Economics to conduct a study of the potential costs and benefits of net metering in the state. The following cost/benefit components were addressed in the study:

1. **Solar Integration Costs**

   Synapse concluded that grid integration costs increase as solar penetration level increases. As penetration levels are low in Mississippi, the authors found a very little evidence that significant costs are incurred by grid operators or distribution companies. Synapse referred to Xcel Energy's Colorado report, which concludes DG would add $2 per MWh in costs at a penetration level of 2%, which is four times that of Mississippi.

2. **Administrative Costs**

   Since data on net metering costs from all states is not available or easily separable from the program costs, the authors collected cost data for energy efficiency programs from many states, which is widely available. The authors estimated that an average utility spends between 6% and 9% of energy efficiency program expenses on administrative costs (average is 7.5%). The authors compared the dataset for net metering programs in California and Vermont to their respective energy efficiency programs. Administration costs for net metering were less than energy efficiency programs, so this provides a high-end estimate. Energy efficiency programs in Mississippi cost approximately $12 million, and 7.5% of $12 million is $0.9 million.

3. **Avoided Energy**

   Avoided energy costs are estimated by multiplying the per-MWh variable operating and fuel costs of the marginal resource by the projected MWh of solar generation modeled in each year. The authors used data from the U.S. Energy Information Administration's 2014 Annual Energy Outlook (AEO) to calculate O&M costs. For fuel costs, they used AEO 2014 data to project costs on a MMBtu basis and unit heat rates to convert fuel costs to dollars per MWh.

4. Avoided Generation Capacity

Avoided generation capacity value is calculated as the contribution of solar net metering projects to increasing capacity availability within the state. The authors calculated the amount of installed capacity every year (assumed 88 MW for analysis) and calculated the number of MW that contribute to reduction in peak load by using an Effective Load Carrying Capability (ELCC) of 58%. Thus, capacity contribution will be 58% of 88MW, which is 51 MW. The authors multiplied this capacity contribution by the capacity value in each year and divided this by total solar generation in that year to yield a dollars per MWh value.

5. Avoided Transmission and Distribution Capacity

The authors used an in-house database to calculate avoided T&D costs calculated for DG and energy efficiency programs to provide a rough estimate. Average avoided transmission costs from the database were set as $33 per kW per year. Average avoided distribution costs were $55 per kW per Year. The database includes studies of avoided T&D costs from over 20 utilities and distribution companies. The authors developed a low, mid, and high estimate for these costs by taking the 75^{th} percentile for the high value, the 25^{th} percentile for low value, and the average of these two for the mid value.

6. Avoided Risks/Price Hedging

The report notes that a number of risks are reduced as a result of renewable generation. The risk reduction benefit estimation was done by applying an adder (adjustment factor) to the avoided costs rather than attempting a technical analysis. Current optimal practice supports a 10% adder to avoided costs of renewables like solar.

7. Avoided System/Line losses

Synapse's analysis estimates avoided system losses using a weighted average line loss during each daylight hour. This is calculated by weighing daylight line losses of each T&D system in proportion to the load each system serves. Avoided system losses were calculated as product of weighted average system losses and projected generation from solar panels in each year (in kWh) times the avoided energy cost (in dollars per kWh) in the same year.

8. Environmental Compliance/Benefits

Environmental benefits calculated are primarily associated with avoided CO_2 emissions. The authors' analysis uses the mid case of their avoided environmental compliance estimation. It is forecasted that a carbon price begins in 2020 at $15 per ton and increases to $60 per ton in 2040. Entergy has developed a system-wide integrated resource plan, which modeled a CO_2 price in its reference case. Other greenhouse gases, such as SO_x and NO_x, are not mentioned.

9. Market Price Suppression

Market price suppression effects are acknowledged in the report, but are not monetized.

10. Local Economic Benefits

Local economic benefits are not included. Although it is mentioned that PV provides the most job-years per average megawatt, this benefit is not monetized.

11. Ancillary Services

Grid support services/ancillary services are addressed in the report, but are not monetized.

Appendix III.D: Summary of Study: *Distributed Generation – Integrated Value (DG-IV): A Methodology to Value DG on the GRID (Electric Power Research Institute and DG-IV Stakeholders, 2015)*

The purpose of the report was to select cost/benefit categories for inclusion in a framework and develop a firm analytical basis for calculating each of these categories. The stakeholders examined value of solar studies from other jurisdictions to identify categories to include. The study was limited to rooftop solar. A transparent, fair, adaptable, versatile methodology was to be created.

The stakeholders, after due deliberation, arrived at the following DG-IV components:

Categories	Description
Avoided Energy	Fuel, variable operations and maintenance, and start-up value
Generation Capacity Deferral	Capital and fixed operations and maintenance
Transmission System Impact	Net change (transmission required, deferred, or eliminated)
Distribution System Impact	Net change (distribution required, deferred, or eliminated)
T&D Losses	Net change in T&D system losses
Environmental Impact	Compliance (e.g., CO_2, coal ash, cooling water) and market (renewable energy credits) value
Local Power Company (LPC) Costs & Benefits	Cost of implementing renewable energy programs (administrative, operational, engineering) and LPC-specific distribution system benefits
Economic Development	Regional job and economic growth
Customer Satisfaction	Value associated with preference, optionality, and flexibility
Local Differentiation	Site-specific benefits

System Integration/Ancillary Services	Symbiotic value of smart grid and high levels of DG, as well as integration costs
Additional Environmental Considerations	Environmental benefits not part of the compliance and market values included above
Security Enhancement	Increased resiliency
Disaster Recovery	System restoration assistance after natural disasters
Technology Innovation	Impact value of technology-driven investment

☐ = Included in DG-IV Methodology
☐ = Program Design Considerations
☐ = Placeholder Topics

For the purpose of the report, a multiplier – Net Dependable Capacity (NDC) is used for capacity-related benefits. This multiplier is similar to the ELCC term discussed in other reports. The NDC reflects the proportion of PV capacity that offsets conventional generation capacity. The system peak and solar output at that time are compared to calculate NDC.

Evaluation of these quantities was carried out using TVA's Resource Planning Process - [RPP] (Figure A4). The process computes two quantities (capital costs in $/kW, and production costs $/kWh). The net result is the Total Plan Cost. The methods used to compute the main components are as follows:

1. **Avoided Energy:** The Resource Planning Process is run with and without PV using an hourly time-step. The cost of PV is not considered. The value depends upon the avoided resource and the fuel price.

2. **Generation Deferral:** The Resource Planning Process is run with and without PV for a period of 20 years, using a 50% NDC.

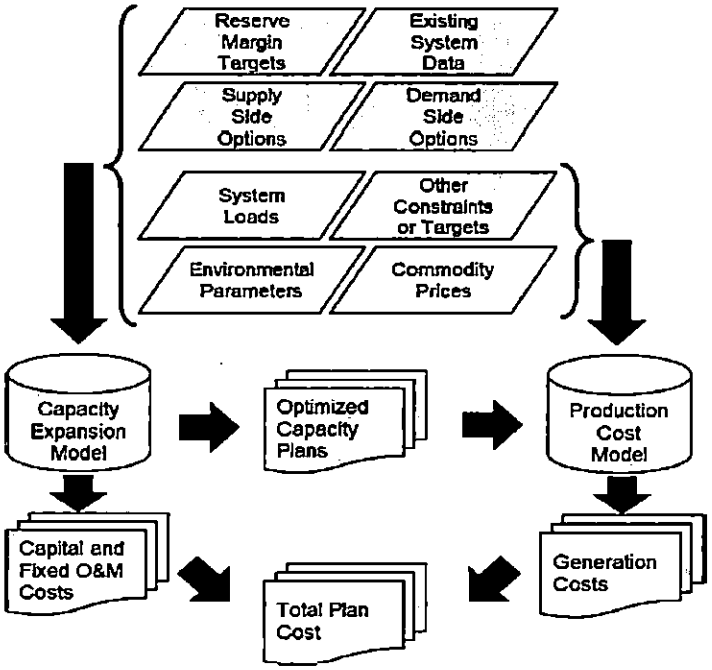

Figure A4: Resource Planning Model Process

3. **Environmental:** This includes two components: (1) Environmental Compliance and (2) Market Value. Environmental compliance value is calculated based on the carbon intensity of the generation assets deferred, and a CO_2 compliance cost curve is assumed beginning in 2022. The market value is based on renewable energy credit (REC) value. A $1/MWh value is assumed, based on national voluntary REC market prices. A 1.9% escalation rate is applied to this, based on TVA's integrated resource planning. Other environmental benefits are considered in the report, but set aside as placeholder categories.

4. **Transmission Impacts and Losses:** The costs and benefits are evaluated by considering the system peak, NDC, PV profile, and avoided costs; a simplified calculation with the point to point service rate is used. Three scenarios are studied: Positive, Negative, and Neutral, and an assumption is made that PV is installed in a manner that will be beneficial to the grid. It was generally observed that losses decrease when PV is added to loaded regions; however, they increase when PV is added to lightly loaded regions due to reverse power flow.

5. **Distribution Impacts and Losses:** System impacts, and marginal losses were studied. EPRI's Integrated Grid Initiative tool was used which incorporated feeder hosting capacity. It was observed that PV will benefit the system up to the hosting capacity after which system performance will deteriorate and need mitigation. No negative impacts were considered in the report.

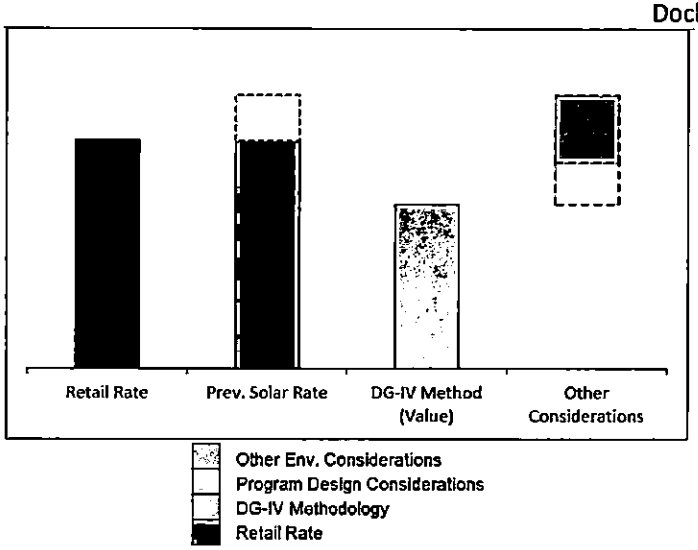

Figure A5: TVA DG-IV Calculation

Overall, it was found that the current compensation rate for PV is higher than that calculated by the DG-IV method (see Figure A5). However, this calculation does not include the other program design considerations and placeholder categories identified by the stakeholder group, and the report notes that this value is intended to be representative and not definitive.

Appendix III.E: Summary of Study: *Evaluation of Net Metering in Vermont Conducted Pursuant to Act 99 of 2014 (Vermont Public Service Department, 2014)*

This study was conducted by the Vermont Public Service Department with the broad purpose of evaluating net metering in the state of Vermont. The study examined six different types of net-metered systems: (1) a 4 kW fixed PV system, (2) a 4 kW 2-axis tracking PV system, (3) a 4 kW wind generator, (4) a

100 kW fixed group net metering PV system, (5) a 100 kW 2-axis tracking group net metering PV system, and (6) a 100 kW group net metering wind system.

Ultimately, the study concluded that the impact of net metering is positive, primarily for those who install distributed generation systems. The study pointed to grid stability and reliability, economic and environmental benefits (they did not attempt to quantify these due to the arbitrary nature of pricing), shared distribution between net-metering and non-net-metering customers, and the current tax credit system as primary net positives for net metering.

1. **Avoided Energy:** The authors assumed that the energy source displaced or avoided by the use of net metering is energy purchased on the ISO-NE real-time spot market. Avoided energy was calculated on an hourly basis by multiplying the production of real Vermont generators by the hourly price set in the ISO-NE market. These calculations indicated that fixed solar PV had a weighted average avoided energy price 9% lower than the annual ISO-NE average spot market price. The capacity factor for each solar technology is projected using the National Renewable Energy Laboratory's PV-Watts tool for a location in Montpelier using all default settings.

2. **Avoided Generation Capacity:** The Department examined the timing of the relevant peaks: ISO-NE's peak for capacity costs, Vermont summer peaks for in-state transmission costs, monthly Vermont peaks for Regional Network Service (RNS) costs and utility specific peak hours for distribution costs. The ability of variable generators to help avoid ISO-NE capacity costs depends on the level of generation during summer hours when ISO-NE's region wide grid demand peaks.

3. **Avoided Regional Transmission Costs:** Regional Network Service (RNS) charges are charged by ISO-NE to each of the region's utilities to pay for the cost of upgrades to the region's infrastructure. These costs are required to meet reliability standards and thus cannot be entirely avoided - only their allocation among New England ratepayers can be changed. Avoiding these costs through net metering shifts the costs to ratepayers from other states. RNS charges are allocated to each utility based on its share of the monthly peak load within Vermont. The values quantified for these costs are based on the ISO-NE forecast for the next three years' worth of RNS charges and escalated based on historical increases in the handy-Whitman Index of public utility construction costs.

4. **Avoided In-State Transmission and Distribution Costs:** These costs are incurred by the state's distribution utilities or VELCO and are not subject to regional cost allocation. Burlington Electric Department forecasts show that even without the effects of energy efficiency, there are no load growth related infrastructure investments planned for next 20 years, hence these costs have been excluded. In-state transmission and distribution upgrades deferred due to load reduction are calculated considering the critical value of how much generation the grid can rely on during peak times. Reliability peak coincidence values were calculated separately from economic peak coincidence values.

5. **Market Price Suppression:** The Department approximated this using an analysis based on the 2013 Avoided Energy supply cost study calculations of the demand reduction induced price effect for Vermont.

6. **Renewable Energy Credit Value:** A fixed value of $30/MWh is assumed. Potential future regulatory value in REC retirement to utilities. (At the time of this study, Vermont did not have a mandatory renewable portfolio standard (RPS). In 2015, the Vermont legislature adopted a binding RPS of 75% by 2032.)

7. **Environmental Compliance:** Analysis was done for the state's non-participating ratepayers both with and without an externalized cost of greenhouse gas emissions. The authors assumed a value of $100/metric ton of CO_2.

The Department also considered three costs as part of its cost-benefit analysis:

1. **Lost Utility Revenue (Due to Reduced Bills):** The Department considered the cost of lost utility revenue due to net metering customers paying lower bills.

2. **Administrative Costs:** Administrative costs are assumed to be the same values as reported in "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012." Wherein, it was assumed that administrative costs are composed of two types of costs: procedural and billing. The authors calculated the combined annual value as $200,000. This corresponds to a set-up cost of approximately $20 per kW of net metering system capacity, ongoing costs of about $20 per kW per year for billing group net-metered systems, and no ongoing billing cost for individual net-metered systems.

3. **Vermont Solar Credit:** Credit for net excess generation is provided at the blended residential rate.

It is notable that solar integration costs are not included in the Department's analysis, particularly given that Vermont has one of the highest percentages of installed solar capacity in the country (the state's net metering aggregate capacity limit of 15% was surpassed by Green Mountain Power in 2016).

The Department carried out its analysis on various systems to determine if cross subsidization is occurring. The Department ultimately found that the aggregate net cost over 20 years to non-participating ratepayers due to net metering under the current policy framework is close to zero. Therefore, there does not need to be a direct link between the value provided by DG resources and the amount or form of compensation provided through net metering program. The Department stated that in order to achieve long-term goals for DG deployment, compensation may need to be greater than the value provided for particular technologies or time periods.

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JENNINGS CONFIDENTIAL EXHIBIT NO. 7

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Final Status Report - SOW 3: Rankin Development
Report: December 12, 2017
Project Completed July 2017
by : Green Energy Corp, John S. Camilleri

The activities of this SOW include the following:

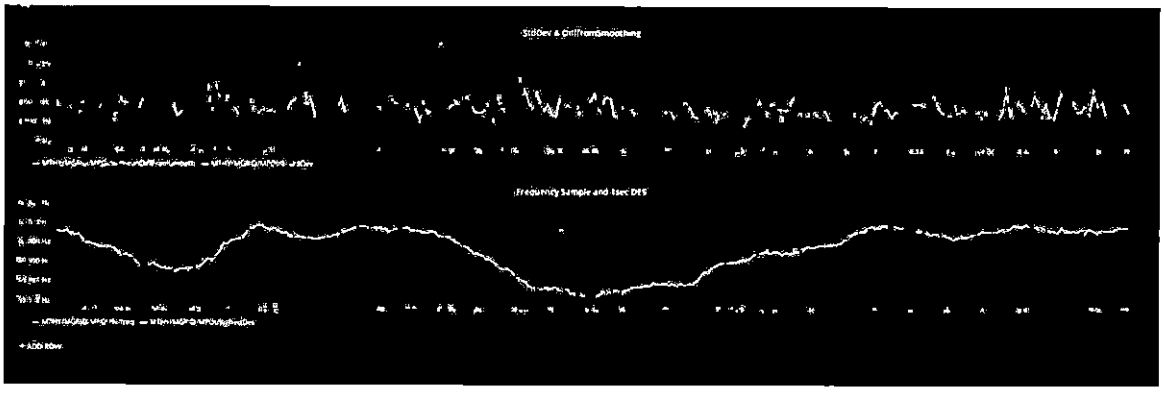
1. Detailed Requirement Documented
2. DDS Adapters to support field communications
3. C37.118 OpenFMB Adapter + Island Detection Application
4. Implement POI Service for multiple DER on Feeder. (Modified - See below)

Task 1 and 2 were completed in 2016.

Task 3 involved creating a PMU OpenFMB Driver. The specification was produced and reviewed in 2016. The adapter was created and tested on the Mount Holly Microgrid system. The project repo (PMU Adapter) was shared with Duke Energy.

The island detection application will use local time series values within the microgrid to attempt and detect an islanding event without proper Point of Common Coupling(PCC) operation. This will be a application running on an edge node. GEC will develop the algorithm approach and deploy in Mount Holly for testing. The application will also monitor other devices in the system including the PCC and Battery System.
The adapter was created and tested on the Mount Holly Microgrid system. The project repo (PMU Adapter) was shared with Duke Energy.

The charts below show the algorithm running in Mount Holly.



Task 4 will document the islanding application in Task 3 and the expected communication configuration and operation of the monitored devices. This

documentation will also consider the application in a configuration with DER on a distribution circuit.

All tasks have been completed. Code and documentation were turned over to Duke Energy. The ETO Team at Mount Holly continue to pursuing further experimentation on their own.

Appendix A: Code Readme Documentation

Part of task #4.

Repo - PMU-Adapter

Projects:

- pmu-adapter-protocol: Library for connecting to C37 protocol connections. Implements Netty protocol handlers.
- pmu-adapter-publisher: GreenBus Edge endpoint publisher that reads PMU data and publishes aggregate statistics.
- pmu-adapter (assembly): Packages PMU adapter as runnable service.

Important classes:

- UnbufferedDes: Implements double-exponential smoothing on a time series.
- PmuTcpHandler: Netty handler that decodes PMU protocol frames and passes results to an observer.
- PmuEndpoint: Observes a PMU connection, keeping running statistics and publishing at an interval.

Appendix B: Application Documentation

Part of task #4

Problem Statement

Detecting variations in trending values can be useful for identifying anomalies in a system. In an electrical system where distributed generation is deployed certain conditions can arise that produce a safety issue. One of these conditions is called `unintended islanding`.

Typically this is where the main source of the feeder or microgrid has been interrupted and power is flowing backwards from the DER or Microgrid across the Point of Common Coupling (PCC). This is where the PCC did not operate or the DER did not shutdown appropriately to stop the backflow. This backflow could be feeding a low current fault, energizing a portion of the line that crews might be working on and/or damaging customer equipement due to poor power quality.

Being able to detect and then provide automatic control cost effectively is the ultimate goal.

Approach

The selected approach identifies and attempts to rectify the problem uses several technologies. The first technology was developed by Green Energy Corp and allows a distributed application to run in the field on a CPU Node in front of the PMU. The second technology was implemented by Netflix to support Operational Insight for millions of trending values. Netflix implemented an algorithm call Double Exponential Smoothing (DSM) to predict and support anomaly detection.

As specified in Task #3 above, GEC will implement and deploy the approach described.

Location of Deployment

Duke Energy has deployed a SEL 735 which provides C37.118. It is located between the PCC and POI at Mount Holly and will enable Duke Energy to monitor high resolution frequency and /or voltage phase angles at that location. It should be noted that this location is not part of the Microgrid so that when the Microgrid Islands the SEL 735 will still see the grid side measurements.

Breath of Solution

This approach has numerous applications for in-field analytics. Some of the potential areas include detecting voltage anomalies at distribution transformers to determine bad windings. Identification of excess current draws on motors indicating short circuits in the armatures.

This approach can enable a low cost power quality monitoring system that can also integrate with other in-field analytics and data to predict system level behaviour.

Basic Mathematical Approach

The Double Exponential Smoothing (DES) uses two equations[^1]

S_t = $\alpha*y_t$ + (1 + α)($S_(t-1)$ + $B_(t-1)$)

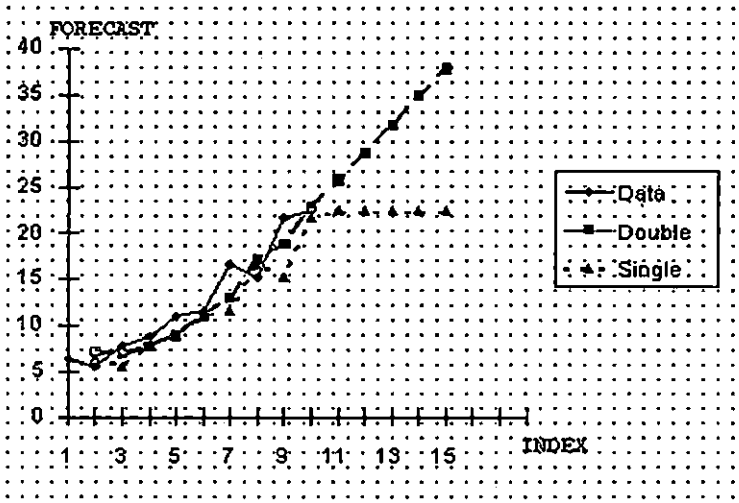
where $0 \le \alpha \le 1$

b_t = γ*($S_t - S_(t-1) +(1-\gamma)*b_(t-1)$

where $0 \le \gamma \le 1$

Both α and γ have to be tuned to for the specific trending variable.

The following graph from NIST shows the DSE and forecast based on DES and exponential smoothing with the actual data.



The based concept is to monitor the variation between the actual and DES forecasted to determine when the actual is *out of range* to trigger an anomaly event.

Coding Approach

Green Energy Corp will take the open source version of DES from Netflix[^2] as the base algorithm. A PMU adapter will be implemented on GreenBus Edge to support communication with the the SEL 735. This is based off of previous work[^3]. There are also other implementation of DES[^4] that are liberally licensed on `github` for further consideration.

Observations

The system will be able to be tuned and monitored for the Mount Holly Data Center. This will allow Duke and GEC to determine the best parameters and the limit settings for detecting anomalies of the trended values. The specific goal of this demonstration is to verify an approach to implement automatic control based on the analytics, therefore we will only implement events to be logged in the system for verification.

References

[^1]:NIST Definition of DES

[^2]:Netflix Project

[^3]: C37.118 - OpenFMB Adapter Design Document

[^4]:DES github reference

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JENNINGS CONFIDENTIAL EXHIBIT NO. 10

DOCKET NO. E-2, SUB 1175

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BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-2, SUB 1175

In the Matter of:	)	
	)	
Application of Duke Energy Progress, LLC for Approval of Renewable Energy and Energy Efficiency Portfolio Standard (REPS) Compliance Report and Cost Recovery Rider Pursuant to N.C. Gen. Stat. 62-133.8 and Commission Rule R8-67	)	**APPLICATION FOR APPROVAL OF REPS COST RECOVERY RIDER AND 2017 REPS COMPLIANCE REPORT**

Duke Energy Progress, LLC ("DEP" or the "Company"), pursuant to N.C. Gen. Stat. § 62-133.8 and Rule R8-67 of the Rules and Regulations of the North Carolina Utilities Commission ("Commission"), hereby makes this Application (1) for approval of its 2017 Renewable Energy Portfolio Standard ("REPS") Compliance Report, and (2) to implement a monthly charge to recover the incremental costs associated with compliance with the REPS. In support of this Application, the Company respectfully shows the following:

1. The Company is a public utility operating in the states of North Carolina and South Carolina where it is engaged in the generation, transmission, distribution, and sale of electricity for compensation. Its general offices are located at 410 South Wilmington Street, Raleigh, North Carolina, and its mailing address is Post Office Box 1551, Raleigh, North Carolina 27602.

2. The attorneys for the Company, to whom all communications and pleadings should be addressed, are:

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3. N.C. Gen. Stat. § 62-133.8 requires North Carolina's electric power suppliers to supply six (6) percent of their North Carolina retail kilowatt hours ("kWh") from "renewable resources," as that term is defined by N.C. Gen. Stat. § 62-133.8(a)(8), for calendar year 2017. Further, N.C. Gen. Stat. § 62-133.8(d) requires that the electric power suppliers also obtain 0.14 percent of their North Carolina retail kWh from solar photovoltaic or thermal solar resources in 2017. Further, N.C. Gen. Stat. § 62-133.8(e) and (f) require that the electric power suppliers also obtain their allocated share of the state-wide requirement of 0.14 percent of the total North Carolina retail kWh sold from swine waste resources and 900,000 megawatt hours ("MWh") of the total electric power sold to North Carolina retail customers from poultry waste resources, respectively, in 2017.[1]

4. N.C. Gen. Stat. § 62-133.8(h) provides that the electric public utilities shall be allowed to recover the incremental costs[2] associated with complying with N.C.

[1] Both the Poultry Waste and Swine Waste Set-Aside requirements established by N.C. Gen. Stat. § 62-133.8 have been modified by Commission order pursuant to N.C. Gen. Stat. § 62-133.8(i)(2), as discussed herein.

[2] "Incremental costs" are defined as (1) all reasonable and prudent costs incurred by an electric utility to meet the solar and renewable generation requirements of the statute that are in excess of the utility's avoided costs, and (2) costs associated with research that encourages the development of renewable energy, energy efficiency, or improved air quality, provided those research costs do not exceed one million dollars ($1,000,000) per year.

Gen. Stat. § 62-133.8 through an annual rider not to exceed the following per-account charges:

Customer Class	2008-2011	2012-2014	2015 and thereafter
Residential per account	$ 10.00	$ 12.00	$ 27.00
Commercial per account	$ 50.00	$ 150.00	$ 150.00
Industrial per account	$ 500.00	$ 1,000.00	$1,000.00

The statute provides that the Commission shall ensure that the incremental costs to be recovered from individual customers on a per-account basis are in the same proportion as the per-account annual charges for each customer class set out in the chart above.

5. Rule R8-67(c) requires the Commission to conduct an annual proceeding for each electric public utility to review the utility's costs to comply with N. C. Gen. Stat. § 62-133.8 and establish the electric public utility's annual rider to recover such costs in a timely manner. The Commission shall also establish an experience modification factor ("EMF") to collect the difference between the electric public utility's actual reasonable and prudent REPS costs incurred during the test period and the actual revenues incurred during the test period. Rule R8-67(c) further provides that the Commission shall consider each electric public utility's REPS compliance report at the hearing provided for in Rule R8-67(e) and shall determine whether the electric public utility has complied with N.C. Gen. Stat. § 62-133.8(b), (d), (e) and (f).

6. According to Rules R8-67(c) and (e), the electric public utility is to file its application for recovery of its REPS costs, as well as its REPS compliance report, at the same time it files the information required by Rule R8-55, and the Commission is to conduct an annual rider hearing as soon as practicable after the hearing required by Rule R8-55.

7. Pursuant to the provisions of N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67(e), DEP requests the Commission to establish a rider to recover its reasonable and prudent forecasted REPS compliance costs to be incurred during the rate period. As provided in Rule R8-67(e), the Company requests to collect from DEP's retail customers, through the EMF, $410,708 of REPS costs incurred and other credits for the period April 1, 2017 through March 31, 2018 ("EMF Period") and collect from DEP's retail customers $40,959,120 for REPS costs to be incurred during the rate period from December 1, 2018 through November 30, 2019 ("Billing Period"). The REPS rider and EMF will be in effect for the twelve month period December 1, 2018 through November 30, 2019.

8. Pursuant to the provisions of N.C. Gen. Stat. § 62-133.8 and Rule R8-67, DEP requests Commission approval of the annual billing statements, including both the REPS monthly charge and the EMF monthly charge, for each customer class as follows:

Customer Class	**REPS Monthly Charge** (excl. regulatory fee)	**Monthly EMF** (excl. regulatory fee)	**Total REPS Monthly Charge** (excl. regulatory fee)	**Total REPS Monthly Charge** (incl. regulatory fee)
Residential	$ 1.30	$ 0.12	$ 1.42	$ 1.42
General[3]	$ 8.61	$ (0.66)	$ 7.95	$ 7.96
Industrial	$ 64.96	$ 8.11	$ 73.07	$ 73.17

The calculation of these rates is set forth in Exhibit No. 4 of the direct testimony of Veronica I. Williams filed with this Application.

9. Pursuant to Commission Rule R8-67(e)(8), DEP requests approval to defer the difference between actual reasonable and prudently incurred incremental costs and

[3] Duke Energy Progress' General Service rate schedule generally covers the class of customers intended to be captured by the "Commercial" class included within N.C. Gen. Stat. § 62-133.8. The Company does not have a rate schedule for "Commercial" customers.

the related revenues realized under rates in effect. FERC account 182.3, "Other Regulatory Assets," will be used to defer these costs until recovered.

10. Further, pursuant to the provisions of N.C. Gen. Stat. § 62-133.8 and Commission Rule R8-67(c), the Company requests Commission approval of its 2017 REPS Compliance Report, attached as an exhibit to the direct testimony of Megan W. Jennings filed in support of this Application. As described by Ms. Jennings' testimony, and illustrated in DEP's 2017 REPS Compliance Report, the Company has complied with the requirements of N.C. Gen. Stat. § 62-133.8(b) and (d) for 2017. In its October 16, 2017 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief,* in Docket No. E-100, Sub 113, the Commission directed that the 2017 Poultry Waste Set-Aside requirement (N.C. Gen. Stat. § 62-133.8(f)) remain at the same level as the 2016 requirement, which the Commission had previously approved at 170,000 MWh, and delayed by one year the scheduled increases in that requirement. The Commission also further delayed for one year the Swine Waste Set-Aside requirement; accordingly, those requirements will now commence in compliance year 2018.[4] The Company has complied with this modified Poultry Waste Set-Aside requirement.

[4] In its *Order Modifying the Poultry and Swine Waste Set-Aside and Granting Other Relief* also issued in Docket No. E-100, Sub 113 (November 29, 2012), the Commission eliminated the Swine Waste Set-Aside requirement for 2012 and delayed for one year the Poultry Waste Set-Aside requirement (from 2012 to 2013). In its March 26, 2014 *Order Modifying the Poultry and Swine Waste Set-Aside Requirements and Providing Other Relief*, the Commission delayed the Swine and Poultry Waste Set-Aside requirements for an additional year, so that the Swine Waste Set-Aside requirements for 2014-2015 were 0.07 percent and the Poultry Waste Set-Aside requirement for 2014 was 170,000 MWh. In its November 13, 2014 *Order Modifying the Swine Waste Set-Aside Requirement and Providing Other Relief*, the Commission directed that the Swine Waste Set-Aside requirement remain at 0.07 percent for the years 2015-2016. Subsequently, in its December 1, 2015 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief*, the Commission directed that the Swine Waste Set-Aside requirement for 2015 be delayed an additional year and that the Poultry Waste Set-Aside requirement for 2015 would be the same as the 2014 level. In its October 17, 2016 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief,* the Commission directed that the 2016 Poultry Waste Set-Aside Requirement remain at the same level as the 2015 requirement and delayed by one year the scheduled

11. The information and data required to be filed under Commission Rule R8-67 is contained in the direct testimony and exhibits of witnesses Jennings and Williams, which are being filed simultaneously with this Application and incorporated herein by reference.

WHEREFORE, the Company respectfully requests:

That consistent with this Application, the Commission approves the Company's 2017 REPS Compliance Report and allows the Company to implement the rate riders as set forth above.

Respectfully submitted, this the 20th day of June, 2018.

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increases in that requirement. The Commission also further delayed commencement of the Swine Waste Set-Aside Requirement until 2017.

VERIFICATION

STATE OF NORTH CAROLINA)
)
COUNTY OF MECKLENBURG)

DOCKET NO. E-2, SUB 1175

Veronica I. Williams, being first duly sworn, deposes and says:

That she is Rates and Regulatory Strategy Manager for Duke Energy Carolinas, LLC; that she has read the foregoing Application for Duke Energy Progress, LLC and knows the contents thereof; that the same is true except as to those matters stated on information and belief; and as to those matters, she believes them to be true.

Veronica I. Williams

Sworn to and subscribed before me
this the 13 day of June, 2018.

Notary Public

PATRICIA C. ROSS
NOTARY PUBLIC
Mecklenburg County
North Carolina

My Commission Expires: 10-17-2019