PRESSON EXHIBIT NO. 1
*****REDACTED VERSION*****

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. E-2, SUB 1293

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of	)	
	)	DUKE ENERGY PROGRESS,
Application of Duke Energy Progress, LLC for	)	LLC 2021 RENEWABLE
Approval of Renewable Energy and Energy	)	ENERGY & ENERGY
Efficiency Portfolio Standard Compliance Report	)	EFFICIENCY PORTFOLIO
and Rider Pursuant to N.C. Gen. Stat. § 62-133.8	)	STANDARD COMPLIANCE
and Commission Rule R8-67(c)	)	REPORT

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

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(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 2021.[1]

(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 2021.

[BEGIN CONFIDENTIAL]

[redacted]

[redacted]

[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 2021 TOTAL NORTH CAROLINA RETAIL SALES AND YEAR-END NUMBER OF ACCOUNTS, BY CUSTOMER CLASS:

	2021
NC Retail MWh Sales (MWh)	36,578,148

Customer class	**2021** year-end number of accounts
Residential	1,328,488
General	213,452
Industrial	1,736

III. AVOIDED COST RATES

Appendix 1 shows the current avoided cost rates and the avoided cost rates applicable to energy received pursuant to REPS compliance power purchase agreements.

IV. TOTAL AND INCREMENTAL COSTS INCURRED IN 2021

REPS compliance costs incurred for calendar year 2021 comprise the cost of renewable energy purchases, the cost of purchases of various types of RECs, and other reasonable and prudent costs incurred to meet the requirements of the REPS statute. In addition, annual Solar Rebate Program costs incurred pursuant to N.C. Gen. Stat. § 62-155 are recovered in the REPS rider as directed in N.C. Gen. Stat. § 62-133.8(h)(1)d.

Actual Costs Incurred	**Energy and REC Costs**	**Other**	**Total Costs**
REPS compliance - avoided cost	$158,124,818	$ 0	$158,124,818
REPS compliance – incremental cost	$37,226,634	$ 2,471,972	$39,698,606(a)
REPS compliance - total cost	**$195,351,452**	**$2,471,972**	**$197,823,424**
Solar Rebate Program cost	$ 0	$1,914,121	$ 1,914,121(b)
Incremental REPS compliance costs and Solar Rebate Program costs for REPS rider recovery		(a) + (b) above	**$41,612,727**

V. INCREMENTAL COSTS COMPARISON TO THE ANNUAL COST CAP

Account Type	Total 2020 year-end number of retail REPS accounts	Annual per-account cost cap	Total annual cost cap
Residential	1,333,721	$27	$36,010,467
General	214,081	$150	$32,112,150
Industrial	1,908	$1,000	$1,908,000
Total annual REPS compliance cost cap – 2021			**$70,030,617**
Incremental REPS compliance costs incurred – 2021			**$39,698,606**

VI. STATUS OF COMPLIANCE WITH REPS REQUIREMENTS

Pursuant to N.C. Gen. Stat. § 62-133.8(b) for Duke Energy Progress retail customers, the REPS requirement for calendar year 2021 is set at 12.5% of 2020 North Carolina ("NC") retail sales. To comply with the REPS obligation for Duke Energy Progress retail customers, the Company submitted 4,521,943 RECs, representing 12.5% of 2020 retail megawatt-hour sales of 36,175,543. Details of the composition of RECs retired to meet the total REPS compliance requirement are contained in Section I of this report.

Pursuant to N.C. Gen. Stat. § 62-133.8(d), for calendar year 2021, at least 0.20% of the total prior year NC retail sales shall be supplied by a combination of new solar electric facilities and new metered solar thermal energy facilities. As a result, 72,352 solar RECs were submitted for retirement to meet the solar set-aside requirement. An additional 716,976 solar RECs were submitted for retirement toward compliance with the general requirement (the total REPS requirement net of the solar, poultry waste and swine waste set-aside obligations).

In its March 4, 2022 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief* ("2021 Delay Order") issued in Docket No. E-100, Sub 113, the Commission reduced the 2021 statewide poultry waste set-aside requirement to 300,000 MWhs and set the 2022 and 2023 levels at 700,000 MWhs and 900,000 MWhs, respectively. In its December 16, 2019 *Order Establishing 2019, 2020, and 2021 Poultry Waste Set-Aside Requirement Allocation* issued 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 according to the load ratio share calculations shown on Appendix A to the order. These percentages were applied to the modified

2021 statewide requirement to determine the poultry waste set-aside requirements applicable to DEP's NC retail customers for the 2021 reporting year. The Company submitted for retirement 83,850 poultry waste RECs and met its 2021 poultry waste set-aside requirement.

In its December 16, 2019 *Order Modifying the Swine and Poultry Waste Set-Aside Requirements and Providing Other Relief* and its February 13, 2020 *Errata Order* ("2019 Delay Orders") issued in Docket No. E-100, Sub 113, the Commission modified the swine waste set-aside requirement for 2019 and each year thereafter. The 2019 Delay Orders set the 2021 swine waste set-aside at 0.07% of total NC retail sales for electric public utilities. To comply with the swine waste set-aside requirement applicable to DEP's NC retail sales, the Company submitted for retirement 25,323 swine RECs.

VII. IDENTIFICATION OF RECs CARRIED FORWARD

The table below reflects RECs generated through year-end 2021, excluding those RECs that have already been retired to meet compliance, that the Company has banked for use in future compliance years.

[BEGIN CONFIDENTIAL]

[redacted]

[END CONFIDENTIAL]

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

Confidential Appendix 2 details the dates and amounts of all payments made for renewable energy certificates during calendar year 2021.

(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.

Respectfully submitted this the 14th day of June, 2022.

Robert W. Kaylor

Kendrick C. Fentress
Associate General Counsel
Duke Energy Corporation
P.O. Box 1551/NCRH 20
Raleigh, North Carolina 27602
919.546.6733
Kendrick.Fentress@duke-energy.com

Robert W. Kaylor
Law Office of Robert W. Kaylor, P.A.
353 E. Six Forks Road, Suite 260
Raleigh, North Carolina 27609-7882
919.828.5250
bkaylor@rwkaylorlaw.com

DUKE ENERGY PROGRESS, LLC | **Presson Exhibit No. 1, Appendix 1**
Docket No. E-2, Sub 1293 | **June 14, 2022**
2021 REPS Compliance Report - Section III - approved avoided cost rates

Non-Hydro

ANNUALIZED TOTAL CAPACITY AND ENERGY RATES
(CENTS PER KWH)

Docket No.:	**E-100 Sub 167 (Current)**			**E-100 Sub 158**			**E-100 Sub 148**	**E-100, Sub 140**	**E-100, Sub 136**	**E-100, Sub 127**	**E-100, Sub 117**	E-100, Sub 106
	Uncontrolled Solar (1)	Swine-Poultry (2)	All Other (3)	Uncontrolled Solar (1)	Swine-Poultry (2)	All Other (3)	All Other (4)					
Year filed:	2020	2020	2020	2018	2018	2018	2016	2014	2012	2010	2008	2006
Variable Rate	2.64	3.71	2.88	3.21	3.82	3.45	3.35	4.29	4.76	5.79	5.69	4.54
5 Year	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.42	4.97	6.18	5.82	4.67
10 Year	3.36	3.91	3.60	3.39	3.72	3.63	3.79	5.09	5.47	6.82	6.05	4.85
15 Year	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.53	5.87	7.29	6.10	4.98

(1) Uncontrolled Solar includes SISC (System Integration Services Charge) per August 13, 2021 order approving rates in Docket No. E-100, Sub 167
(2) Exception to IRP-designated first year of capacity need standard N.C. Gen. Stat. § 62-156(b)(3)
(3) All Other Except Uncontrolled Solar, Swine-Poultry and Hydro No Storage per August 13, 2021 order approving rates in Docket No. E-100, Sub 167
(4) All Other Except Hydro No Storage

Hydro - No Storage Rates have utilized a PAF of 2.0 in the capacity calculation since Docket No. E-100, Sub 79 (1996) . This has been continued via Hydro Stipulation.
"Certain Hydroelectric" are facilities with power purchase agreements in effect as of July 27, 2017.

ANNUALIZED TOTAL CAPACITY AND ENERGY RATES
(CENTS PER KWH)

Docket No.:	**E-100 Sub 167 (Current)**		**E-100 Sub 158**		**E-100 Sub 148**	**E-100, Sub 140**	**E-100, Sub 136**	**E-100, Sub 127**	**E-100, Sub 117**	**E-100, Sub 106**
	Certain Hydroelectric Generation without Storage (5)	All Other Hydroelectric Generation without Storage (6)	Certain Hydroelectric Generation without Storage (5)	All Other Hydroelectric Generation without Storage (6)	HydroElectric - No Storage (6)					
Year filed:	2020	2020	2018	2018	2016	2014	2012	2010	2008	2006
Variable Rate	4.44	2.88	4.46	3.77	3.35	4.79	5.35	6.49	6.34	4.96
5 Year	N/A	N/A	N/A	N/A	N/A	4.93	5.58	6.90	6.50	5.11
10 Year	4.67	4.09	4.39	4.21	4.09	5.63	6.12	7.57	6.77	5.32
15 Year	N/A	N/A	N/A	N/A	N/A	6.10	6.55	8.06	6.86	5.47

(5) Exception to IRP-designated first year of capacity need standard N.C. Gen. Stat. § 62-156(b)(3).
(6) Hydroelectric no storage N.C. Gen. Stat. § 62-156(b)(3)

DUKE ENERGY PROGRESS, LLC | **Redacted Version**
Docket No. E-2, Sub 1293 | **Presson Exhibit 1, Appendix 2**
2021 REPS Compliance Report | **June 14, 2022**
Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		REC Cost
[BEGIN CONFIDENTIAL]		
[redacted]		
Aug-2021	$	2,183
Dec-2021	$	1,413
Jul-2021	$	3,195
Nov-2021	$	1,361
Oct-2021	$	1,555
Sep-2021	$	1,868
[redacted]		
Apr-2021	$	2,790
Aug-2021	$	5,067
Dec-2021	$	6,168
Feb-2021	$	2,350
Jan-2021	$	2,497
Jul-2021	$	4,332
Jun-2021	$	4,479
Mar-2021	$	2,423
May-2021	$	4,112
Nov-2021	$	3,672
Oct-2021	$	4,186
Sep-2021	$	4,112
[redacted]		
Apr-2021	$	6,758
Aug-2021	$	5,222
Dec-2021	$	6,041
Feb-2021	$	2,867
Jan-2021	$	4,096
Jul-2021	$	5,017
Jun-2021	$	5,324
Mar-2021	$	2,560
Nov-2021	$	4,403
Sep-2021	$	11,365
[redacted]		
Apr-2021	$	310
Aug-2021	$	414
Feb-2021	$	207
Jan-2021	$	414
Jul-2021	$	310
Jun-2021	$	310
Mar-2021	$	207
May-2021	$	414
Nov-2021	$	207
Oct-2021	$	414
Sep-2021	$	310
[redacted]		
Apr-2021	$	1,230
Aug-2021	$	2,150
Dec-2021	$	3,055
Feb-2021	$	1,165
Jan-2021	$	1,270
Jul-2021	$	1,795
Jun-2021	$	2,040
Mar-2021	$	1,125
May-2021	$	1,705
Nov-2021	$	1,690
Oct-2021	$	2,040
Sep-2021	$	1,695
[redacted]		
Apr-2021	$	3,780
Aug-2021	$	4,650

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Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		**REC Cost**
Dec-2021	$	3,415
Feb-2021	$	2,885
Jan-2021	$	3,060
Jul-2021	$	4,225
Jun-2021	$	4,990
Mar-2021	$	2,520
May-2021	$	5,065
Nov-2021	$	3,130
Oct-2021	$	4,325
Sep-2021	$	4,400
[redacted]		
Apr-2021	$	1,379
Aug-2021	$	1,735
Dec-2021	$	1,359
Feb-2021	$	983
Jan-2021	$	1,042
Jul-2021	$	1,591
Jun-2021	$	1,566
Mar-2021	$	956
May-2021	$	1,838
Nov-2021	$	1,406
Oct-2021	$	1,591
Sep-2021	$	1,724
[redacted]		
Apr-2021	$	401
Aug-2021	$	720
Dec-2021	$	1,143
Feb-2021	$	358
Jan-2021	$	520
Jul-2021	$	671
Jun-2021	$	720
Mar-2021	$	457
May-2021	$	702
Nov-2021	$	637
Oct-2021	$	758
Sep-2021	$	603
[redacted]		
Apr-2021	$	3,310
Aug-2021	$	7,137
Dec-2021	$	8,998
Feb-2021	$	2,172
Jan-2021	$	4,551
Jul-2021	$	5,896
Jun-2021	$	6,206
Mar-2021	$	827
May-2021	$	5,896
Nov-2021	$	4,241
Oct-2021	$	6,516
Sep-2021	$	5,999
[redacted]		
Apr-2021	$	1,175
Aug-2021	$	2,276
Feb-2021	$	955
Jan-2021	$	1,175
Jul-2021	$	2,129
Jun-2021	$	2,203
Mar-2021	$	1,101
May-2021	$	1,836
Nov-2021	$	1,689
Oct-2021	$	2,129

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Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		**REC Cost**
Sep-2021	$	1,983
[redacted]		
Apr-2021	$	5,728
Dec-2021	$	6,095
Jan-2021	$	2,203
Jul-2021	$	10,207
Jun-2021	$	5,214
Mar-2021	$	2,864
Oct-2021	$	4,479
Sep-2021	$	10,207
[redacted]		
Apr-2021	$	1,878
Aug-2021	$	3,522
Feb-2021	$	2,113
Jan-2021	$	2,583
Jul-2021	$	3,639
Jun-2021	$	3,874
Mar-2021	$	1,878
May-2021	$	2,700
Nov-2021	$	3,287
Oct-2021	$	3,052
Sep-2021	$	3,404
[redacted]		
Apr-2021	$	2,872
Aug-2021	$	3,508
Dec-2021	$	2,752
Feb-2021	$	2,236
Jan-2021	$	2,332
Jul-2021	$	3,340
Jun-2021	$	3,780
Mar-2021	$	1,968
May-2021	$	4,012
Nov-2021	$	2,820
Oct-2021	$	3,240
Sep-2021	$	3,248
[redacted]		
Apr-2021	$	2,112
Aug-2021	$	2,655
Dec-2021	$	2,049
Feb-2021	$	1,608
Jan-2021	$	1,707
Jul-2021	$	2,601
Jun-2021	$	2,847
Mar-2021	$	1,461
May-2021	$	2,985
Nov-2021	$	2,082
Oct-2021	$	2,541
Sep-2021	$	2,598
[redacted]		
Apr-2021	$	73
Aug-2021	$	147
Dec-2021	$	73
Jan-2021	$	73
Jul-2021	$	73
Jun-2021	$	73
Mar-2021	$	73
May-2021	$	147
Nov-2021	$	73
Oct-2021	$	73
Sep-2021	$	73

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Counterparty and Payment Dates		REC Cost
[redacted]		
Apr-2021	$	73
Aug-2021	$	147
Dec-2021	$	73
Feb-2021	$	73
Jul-2021	$	147
Jun-2021	$	73
Mar-2021	$	73
May-2021	$	147
Nov-2021	$	73
Oct-2021	$	147
Sep-2021	$	73
[redacted]		
Apr-2021	$	2,640
Aug-2021	$	3,508
Dec-2021	$	2,592
Feb-2021	$	1,956
Jan-2021	$	2,052
Jul-2021	$	3,304
Jun-2021	$	3,580
Mar-2021	$	1,964
May-2021	$	3,828
Nov-2021	$	2,688
Oct-2021	$	3,148
Sep-2021	$	3,276
[redacted]		
Apr-2021	$	352
Aug-2021	$	352
Dec-2021	$	235
Feb-2021	$	235
Jan-2021	$	235
Jul-2021	$	470
Jun-2021	$	352
Mar-2021	$	117
May-2021	$	352
Nov-2021	$	352
Oct-2021	$	352
Sep-2021	$	352
[redacted]		
Apr-2021	$	235
Aug-2021	$	352
Dec-2021	$	235
Feb-2021	$	103
Jan-2021	$	207
Jul-2021	$	352
Jun-2021	$	352
Mar-2021	$	207
May-2021	$	352
Nov-2021	$	352
Oct-2021	$	352
Sep-2021	$	352
[redacted]		
Apr-2021	$	-
Aug-2021	$	6,716
Dec-2021	$	-
Feb-2021	$	-
Jan-2021	$	-
Jul-2021	$	12,094
Jun-2021	$	-
Mar-2021	$	-

Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		REC Cost
May-2021	$	-
Oct-2021	$	916
Sep-2021	$	8,200
[redacted]		
Apr-2021	$	2,497
Aug-2021	$	5,287
Dec-2021	$	5,214
Feb-2021	$	1,469
Jan-2021	$	2,203
Jul-2021	$	4,259
Jun-2021	$	4,553
Mar-2021	$	2,056
May-2021	$	4,039
Nov-2021	$	3,525
Oct-2021	$	4,259
Sep-2021	$	4,259
[redacted]		
Apr-2021	$	12,731
Aug-2021	$	15,508
Dec-2021	$	12,575
Feb-2021	$	9,367
Jan-2021	$	9,833
Jul-2021	$	13,076
Jun-2021	$	12,920
Mar-2021	$	8,729
May-2021	$	13,662
Nov-2021	$	12,679
Oct-2021	$	14,473
Sep-2021	$	15,197
[redacted]		
Apr-2021	$	3,120
Aug-2021	$	3,848
Dec-2021	$	2,812
Feb-2021	$	2,092
Jan-2021	$	2,144
Jul-2021	$	3,436
Jun-2021	$	3,888
Mar-2021	$	2,064
May-2021	$	4,068
Nov-2021	$	3,012
Oct-2021	$	3,460
Sep-2021	$	3,636
[redacted]		
Apr-2021	$	38,881
Feb-2021	$	109,181
Jan-2021	$	102,997
Mar-2021	$	83,337
[redacted]		
Apr-2021	$	3,565
Aug-2021	$	4,820
Dec-2021	$	7,755
Feb-2021	$	2,735
Jan-2021	$	2,815
Jul-2021	$	4,355
Jun-2021	$	4,835
Mar-2021	$	2,480
May-2021	$	4,825
Oct-2021	$	4,535
Sep-2021	$	4,545
[redacted]		

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2021 REPS Compliance Report | **June 14, 2022**
Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		**REC Cost**
Apr-2021	$	2,984
Aug-2021	$	3,708
Dec-2021	$	2,532
Feb-2021	$	2,164
Jan-2021	$	2,216
Jul-2021	$	3,404
Jun-2021	$	3,856
Mar-2021	$	2,056
May-2021	$	3,980
Nov-2021	$	2,300
Oct-2021	$	3,440
Sep-2021	$	3,464
[redacted]		
Apr-2021	$	3,060
Aug-2021	$	3,736
Dec-2021	$	2,128
Feb-2021	$	1,408
Jan-2021	$	1,328
Jul-2021	$	3,568
Jun-2021	$	3,648
Mar-2021	$	1,848
May-2021	$	4,036
Nov-2021	$	2,692
Oct-2021	$	3,268
Sep-2021	$	3,636
[redacted]		
Apr-2021	$	3,355
Aug-2021	$	4,185
Dec-2021	$	3,315
Feb-2021	$	2,515
Jan-2021	$	2,385
Jul-2021	$	3,995
Jun-2021	$	4,370
Mar-2021	$	2,395
May-2021	$	4,525
Nov-2021	$	3,280
Oct-2021	$	3,595
Sep-2021	$	3,770
[redacted]		
Apr-2021	$	17,572
Aug-2021	$	9,126
Dec-2021	$	8,305
Jan-2021	$	6,769
Jul-2021	$	18,090
Mar-2021	$	8,562
May-2021	$	9,590
Nov-2021	$	7,668
Oct-2021	$	8,035
Sep-2021	$	9,796
[redacted]		
Apr-2021	$	2,084
Aug-2021	$	3,624
Dec-2021	$	2,688
Feb-2021	$	2,020
Jan-2021	$	2,152
Jul-2021	$	3,244
Jun-2021	$	3,692
Mar-2021	$	1,944
May-2021	$	3,880
Nov-2021	$	2,828

Counterparty and Payment Dates		REC Cost
Oct-2021	$	3,216
Sep-2021	$	3,456
[redacted]		
Apr-2021	$	293,940
Aug-2021	$	563,760
Feb-2021	$	546,360
Jan-2021	$	547,800
Jul-2021	$	1,398,120
Mar-2021	$	297,060
May-2021	$	512,160
Nov-2021	$	783,900
Oct-2021	$	842,220
Sep-2021	$	593,940
[redacted]		
Apr-2021	$	14,033
Aug-2021	$	15,815
Dec-2021	$	12,919
Feb-2021	$	9,355
Jan-2021	$	9,989
Jul-2021	$	15,815
Jun-2021	$	16,260
Mar-2021	$	8,910
May-2021	$	19,156
Nov-2021	$	11,805
Oct-2021	$	14,701
Sep-2021	$	16,260
[redacted]		
Apr-2021	$	3,170
Aug-2021	$	3,991
Dec-2021	$	3,287
Feb-2021	$	2,348
Jan-2021	$	2,465
Jul-2021	$	3,639
Jun-2021	$	3,991
Mar-2021	$	2,230
May-2021	$	4,343
Nov-2021	$	3,287
Oct-2021	$	3,874
Sep-2021	$	3,756
[redacted]		
Aug-2021	$	3,874
Dec-2021	$	5,400
Feb-2021	$	1,996
Jan-2021	$	2,465
Jul-2021	$	3,639
Jun-2021	$	4,343
Mar-2021	$	1,878
May-2021	$	3,052
Nov-2021	$	3,170
Oct-2021	$	5,635
Sep-2021	$	3,756
[redacted]		
Apr-2021	$	367
Aug-2021	$	896
Dec-2021	$	1,258
Feb-2021	$	455
Jan-2021	$	572
Jul-2021	$	767
Jun-2021	$	853
Mar-2021	$	464

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Counterparty and Payment Dates		REC Cost
May-2021	$	693
Nov-2021	$	821
Oct-2021	$	788
Sep-2021	$	756
[redacted]		
Apr-2021	$	2,928
Aug-2021	$	3,924
Dec-2021	$	3,040
Feb-2021	$	2,236
Jan-2021	$	2,008
Jul-2021	$	3,660
Jun-2021	$	4,096
Mar-2021	$	2,028
May-2021	$	4,152
Nov-2021	$	3,176
Oct-2021	$	3,512
Sep-2021	$	3,440
[redacted]		
Apr-2021	$	5,125
Aug-2021	$	7,383
Dec-2021	$	11,900
Feb-2021	$	3,996
Jan-2021	$	4,734
Jul-2021	$	6,080
Jun-2021	$	7,123
Mar-2021	$	4,386
May-2021	$	6,819
Nov-2021	$	6,341
Oct-2021	$	6,775
Sep-2021	$	5,646
[redacted]		
Apr-2021	$	621
Aug-2021	$	1,138
Feb-2021	$	414
Jan-2021	$	724
Jul-2021	$	1,138
Jun-2021	$	1,034
Mar-2021	$	621
May-2021	$	931
Nov-2021	$	827
Oct-2021	$	1,138
Sep-2021	$	1,034
[redacted]		
Apr-2021	$	2,880
Aug-2021	$	3,560
Dec-2021	$	2,836
Feb-2021	$	2,224
Jan-2021	$	2,296
Jul-2021	$	3,412
Jun-2021	$	3,784
Mar-2021	$	1,984
May-2021	$	4,000
Nov-2021	$	2,824
Oct-2021	$	3,392
Sep-2021	$	3,352
[redacted]		
Apr-2021	$	1,553
Aug-2021	$	1,843
Dec-2021	$	3,231
Feb-2021	$	1,238

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Counterparty and Payment Dates		REC Cost
Jan-2021	$	1,312
Jul-2021	$	1,735
Jun-2021	$	1,937
Mar-2021	$	1,098
May-2021	$	2,133
Oct-2021	$	1,769
Sep-2021	$	1,753
[redacted]		
Apr-2021	$	3,505
Aug-2021	$	4,185
Dec-2021	$	2,470
Feb-2021	$	2,400
Jan-2021	$	2,560
Jul-2021	$	4,220
Jun-2021	$	4,645
Mar-2021	$	2,435
May-2021	$	4,940
Nov-2021	$	3,540
Oct-2021	$	3,025
Sep-2021	$	3,530
[redacted]		
Apr-2021	$	3,645
Aug-2021	$	4,180
Dec-2021	$	3,480
Feb-2021	$	2,555
Jan-2021	$	2,775
Jul-2021	$	4,110
Jun-2021	$	4,285
Mar-2021	$	2,475
May-2021	$	4,745
Nov-2021	$	3,355
Oct-2021	$	3,650
Sep-2021	$	3,630
[redacted]		
Apr-2021	$	235
Aug-2021	$	470
Dec-2021	$	587
Feb-2021	$	117
Jan-2021	$	235
Jul-2021	$	470
Jun-2021	$	470
Mar-2021	$	235
May-2021	$	352
Nov-2021	$	352
Oct-2021	$	470
Sep-2021	$	352
[redacted]		
Apr-2021	$	2,379
Aug-2021	$	2,910
Dec-2021	$	2,151
Feb-2021	$	1,710
Jan-2021	$	1,554
Jul-2021	$	2,673
Jun-2021	$	2,523
Mar-2021	$	1,641
May-2021	$	3,078
Nov-2021	$	2,382
Oct-2021	$	2,679
Sep-2021	$	2,826
[redacted]		

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Counterparty and Payment Dates		REC Cost
Apr-2021	$	3,188
Aug-2021	$	3,644
Dec-2021	$	2,712
Feb-2021	$	2,088
Jan-2021	$	2,308
Jul-2021	$	3,556
Jun-2021	$	3,664
Mar-2021	$	1,916
May-2021	$	4,160
Nov-2021	$	2,992
Oct-2021	$	3,432
Sep-2021	$	3,628
[redacted]		
Apr-2021	$	201,334
Feb-2021	$	192,380
Jan-2021	$	257,952
Mar-2021	$	154,145
May-2021	$	20,868
[redacted]		
Apr-2021	$	195,815
Feb-2021	$	224,969
Jan-2021	$	283,158
Mar-2021	$	209,603
May-2021	$	12,102
[redacted]		
Apr-2021	$	957,580
Aug-2021	$	775,919
Jan-2021	$	1,727,705
Jul-2021	$	962,254
Jun-2021	$	467,360
Mar-2021	$	886,968
May-2021	$	663,448
Nov-2021	$	935,736
Oct-2021	$	608,381
Sep-2021	$	965,200
[redacted]		
Apr-2021	$	3,112
Aug-2021	$	2,452
Dec-2021	$	2,324
Feb-2021	$	1,772
Jan-2021	$	1,840
Jul-2021	$	2,280
Jun-2021	$	2,776
Mar-2021	$	1,540
May-2021	$	4,044
Nov-2021	$	2,852
Oct-2021	$	3,340
Sep-2021	$	2,920
[redacted]		
Apr-2021	$	3,685
Aug-2021	$	3,935
Dec-2021	$	3,520
Feb-2021	$	2,680
Jan-2021	$	2,720
Jul-2021	$	4,320
Jun-2021	$	4,945
Mar-2021	$	2,475
May-2021	$	4,940
Nov-2021	$	3,670
Oct-2021	$	4,360

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Counterparty and Payment Dates		REC Cost
Sep-2021	$	4,545
[redacted]		
Apr-2021	$	1,881
Aug-2021	$	2,142
Dec-2021	$	1,902
Feb-2021	$	1,314
Jan-2021	$	1,557
Jul-2021	$	2,313
Jun-2021	$	2,352
Mar-2021	$	1,170
May-2021	$	2,589
Nov-2021	$	1,914
Oct-2021	$	1,917
Sep-2021	$	2,397
[redacted]		
Apr-2021	$	1,034
Feb-2021	$	1,345
Jan-2021	$	1,551
Mar-2021	$	1,345
May-2021	$	414
[redacted]		
Apr-2021	$	45
Aug-2021	$	360
Feb-2021	$	370
Jan-2021	$	1,220
Jul-2021	$	425
Jun-2021	$	370
Mar-2021	$	285
May-2021	$	85
Oct-2021	$	215
Sep-2021	$	340
[redacted]		
Apr-2021	$	3,515
Aug-2021	$	4,010
Dec-2021	$	3,485
Feb-2021	$	2,515
Jan-2021	$	2,600
Jul-2021	$	3,720
Jun-2021	$	4,470
Mar-2021	$	2,430
May-2021	$	4,765
Nov-2021	$	3,610
Oct-2021	$	3,890
Sep-2021	$	3,785
[redacted]		
Apr-2021	$	117
Aug-2021	$	352
Dec-2021	$	352
Feb-2021	$	117
Jan-2021	$	235
Jul-2021	$	352
Jun-2021	$	352
Mar-2021	$	117
May-2021	$	235
Nov-2021	$	235
Oct-2021	$	352
Sep-2021	$	235
[redacted]		
Apr-2021	$	3,370
Aug-2021	$	4,055

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Dec-2021	$	3,420
Feb-2021	$	2,270
Jan-2021	$	2,825
Jul-2021	$	4,000
Jun-2021	$	4,310
Mar-2021	$	1,770
May-2021	$	4,615
Nov-2021	$	3,405
Oct-2021	$	3,785
Sep-2021	$	3,840
[redacted]		
Apr-2021	$	1,586
Aug-2021	$	1,928
Dec-2021	$	1,631
Feb-2021	$	1,026
Jan-2021	$	1,130
Jul-2021	$	1,816
Jun-2021	$	2,095
Mar-2021	$	990
May-2021	$	2,203
Nov-2021	$	1,625
Oct-2021	$	1,829
Sep-2021	$	1,827
[redacted]		
Apr-2021	$	691
Aug-2021	$	835
Dec-2021	$	1,391
Feb-2021	$	536
Jan-2021	$	608
Jul-2021	$	731
Jun-2021	$	882
Mar-2021	$	410
May-2021	$	740
Nov-2021	$	630
Oct-2021	$	839
Sep-2021	$	792
[redacted]		
Apr-2021	$	235
Dec-2021	$	235
Feb-2021	$	117
Jul-2021	$	352
Jun-2021	$	117
Mar-2021	$	117
Nov-2021	$	117
Oct-2021	$	117
Sep-2021	$	235
[redacted]		
Apr-2021	$	3,425
Aug-2021	$	4,605
Dec-2021	$	3,800
Feb-2021	$	2,815
Jan-2021	$	2,925
Jul-2021	$	3,990
Jun-2021	$	4,490
Mar-2021	$	2,300
May-2021	$	4,790
Nov-2021	$	3,740
Oct-2021	$	4,210
Sep-2021	$	4,365
[redacted]		

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Counterparty and Payment Dates		**REC Cost**
Apr-2021	$	-
Aug-2021	$	37,077
Dec-2021	$	-
Feb-2021	$	-
Jan-2021	$	-
Jul-2021	$	52,709
Jun-2021	$	-
Mar-2021	$	-
May-2021	$	-
Nov-2021	$	-
Oct-2021	$	28,252
Sep-2021	$	37,204
[redacted]		
Apr-2021	$	2,784
Aug-2021	$	3,588
Dec-2021	$	2,784
Feb-2021	$	2,080
Jan-2021	$	2,208
Jul-2021	$	3,380
Jun-2021	$	3,652
Mar-2021	$	2,016
May-2021	$	3,876
Nov-2021	$	2,760
Oct-2021	$	3,272
Sep-2021	$	3,288
[redacted]		
Apr-2021	$	2,830
Aug-2021	$	3,565
Dec-2021	$	2,460
Feb-2021	$	1,850
Jan-2021	$	2,075
Jul-2021	$	3,275
Jun-2021	$	3,670
Mar-2021	$	1,680
May-2021	$	3,865
Nov-2021	$	2,695
Oct-2021	$	3,205
Sep-2021	$	3,400
[redacted]		
Apr-2021	$	3,120
Aug-2021	$	4,295
Dec-2021	$	3,265
Feb-2021	$	2,560
Jan-2021	$	2,455
Jul-2021	$	3,900
Jun-2021	$	4,440
Mar-2021	$	2,420
May-2021	$	4,795
Nov-2021	$	3,175
Oct-2021	$	3,880
Sep-2021	$	3,855
[redacted]		
Apr-2021	$	3,598
Aug-2021	$	4,700
Dec-2021	$	6,315
Feb-2021	$	2,350
Jan-2021	$	2,790
Jul-2021	$	3,818
Mar-2021	$	2,350
May-2021	$	4,920

Counterparty and Payment Dates		REC Cost
Nov-2021	$	3,892
Sep-2021	$	4,920
[redacted]		
Apr-2021	$	480
Aug-2021	$	1,152
Dec-2021	$	1,940
Feb-2021	$	844
Jan-2021	$	864
Jul-2021	$	1,248
Jun-2021	$	1,308
Mar-2021	$	768
May-2021	$	960
Nov-2021	$	1,228
Oct-2021	$	1,192
Sep-2021	$	1,188
[redacted]		
Apr-2021	$	3,710
Aug-2021	$	4,240
Dec-2021	$	3,485
Feb-2021	$	2,640
Jan-2021	$	2,760
Jul-2021	$	3,945
Jun-2021	$	4,545
Mar-2021	$	2,470
Nov-2021	$	3,610
Oct-2021	$	4,190
Sep-2021	$	4,275
[redacted]		
Apr-2021	$	8,168
Dec-2021	$	20,885
Jan-2021	$	8,396
Jul-2021	$	17,680
Mar-2021	$	10,519
May-2021	$	6,307
Oct-2021	$	14,371
Sep-2021	$	31,844
[redacted]		
Apr-2021	$	235
Feb-2021	$	117
Jan-2021	$	235
Jul-2021	$	470
Jun-2021	$	352
Mar-2021	$	235
May-2021	$	352
Sep-2021	$	352
[redacted]		
Apr-2021	$	5,724
Aug-2021	$	7,223
Dec-2021	$	11,085
Feb-2021	$	3,669
Jan-2021	$	4,710
Jul-2021	$	5,906
Jun-2021	$	6,951
Mar-2021	$	4,089
May-2021	$	6,133
Nov-2021	$	4,816
Oct-2021	$	6,406
Sep-2021	$	6,042
[redacted]		
Apr-2021	$	6,222

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Counterparty and Payment Dates		REC Cost
Feb-2021	$	4,461
Jan-2021	$	4,461
Mar-2021	$	4,813
[redacted]		
Apr-2021	$	1,206
Aug-2021	$	1,451
Dec-2021	$	1,159
Feb-2021	$	887
Jan-2021	$	929
Jul-2021	$	1,310
Jun-2021	$	1,602
Mar-2021	$	781
May-2021	$	1,685
Nov-2021	$	1,159
Oct-2021	$	1,379
Sep-2021	$	1,303
[redacted]		
Apr-2021	$	389
Aug-2021	$	657
Dec-2021	$	1,186
Feb-2021	$	439
Jan-2021	$	475
Jul-2021	$	709
Jun-2021	$	835
Mar-2021	$	419
May-2021	$	563
Nov-2021	$	655
Oct-2021	$	635
Sep-2021	$	713
[redacted]		
Apr-2021	$	1,125
Aug-2021	$	1,825
Dec-2021	$	425
Feb-2021	$	1,015
Jan-2021	$	1,110
Jul-2021	$	1,585
Jun-2021	$	1,740
Mar-2021	$	1,020
May-2021	$	1,590
Nov-2021	$	1,305
Oct-2021	$	1,645
Sep-2021	$	1,480
[redacted]		
Apr-2021	$	2,395
Aug-2021	$	2,940
Dec-2021	$	1,960
Feb-2021	$	1,725
Jan-2021	$	1,875
Jul-2021	$	2,880
Jun-2021	$	3,290
Mar-2021	$	1,585
May-2021	$	3,370
Nov-2021	$	2,245
Oct-2021	$	2,835
Sep-2021	$	2,840
[redacted]		
Apr-2021	$	3,395
Aug-2021	$	4,305
Dec-2021	$	6,720
Feb-2021	$	2,600

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Counterparty and Payment Dates		REC Cost
Jan-2021	$	2,620
Jul-2021	$	3,760
Jun-2021	$	4,525
Mar-2021	$	2,330
May-2021	$	4,645
Oct-2021	$	3,955
Sep-2021	$	4,065
[redacted]		
Apr-2021	$	3,040
Aug-2021	$	3,785
Dec-2021	$	3,495
Feb-2021	$	2,500
Jan-2021	$	2,615
Jul-2021	$	2,075
Jun-2021	$	4,215
Mar-2021	$	2,025
May-2021	$	4,800
Nov-2021	$	3,600
Oct-2021	$	4,135
Sep-2021	$	4,070
[redacted]		
Apr-2021	$	587
Feb-2021	$	352
Jan-2021	$	470
Mar-2021	$	470
May-2021	$	587
[redacted]		
Apr-2021	$	3,720
Aug-2021	$	4,860
Dec-2021	$	3,845
Feb-2021	$	2,855
Jan-2021	$	3,000
Jul-2021	$	4,375
Jun-2021	$	4,890
Mar-2021	$	2,195
May-2021	$	5,085
Nov-2021	$	3,880
Oct-2021	$	4,450
Sep-2021	$	4,655
[redacted]		
Apr-2021	$	1,051
Aug-2021	$	781
Feb-2021	$	574
Jan-2021	$	576
Jul-2021	$	851
Jun-2021	$	941
Mar-2021	$	416
Nov-2021	$	846
Sep-2021	$	1,643
[redacted]		
Apr-2021	$	3,625
Aug-2021	$	4,830
Feb-2021	$	2,735
Jan-2021	$	2,940
Jul-2021	$	4,300
Jun-2021	$	4,960
Mar-2021	$	2,550
May-2021	$	5,100
Oct-2021	$	4,445
Sep-2021	$	4,455

Counterparty and Payment Dates		REC Cost
[redacted]		
Apr-2021	$	3,955
Aug-2021	$	5,050
Dec-2021	$	3,735
Feb-2021	$	2,745
Jan-2021	$	2,825
Jul-2021	$	4,565
Jun-2021	$	5,105
Mar-2021	$	2,630
May-2021	$	5,140
Nov-2021	$	3,860
Oct-2021	$	4,660
Sep-2021	$	4,630
[redacted]		
Apr-2021	$	3,585
Aug-2021	$	4,960
Dec-2021	$	3,795
Feb-2021	$	2,825
Jan-2021	$	2,845
Jul-2021	$	4,575
Jun-2021	$	4,930
Mar-2021	$	2,425
May-2021	$	4,845
Nov-2021	$	3,255
Oct-2021	$	4,485
Sep-2021	$	4,715
[redacted]		
Apr-2021	$	2,952
Aug-2021	$	3,544
Dec-2021	$	2,716
Feb-2021	$	2,024
Jan-2021	$	2,136
Jul-2021	$	3,464
Jun-2021	$	3,736
Mar-2021	$	1,976
May-2021	$	3,892
Nov-2021	$	2,820
Oct-2021	$	3,248
Sep-2021	$	3,628
[redacted]		
Apr-2021	$	3,550
Aug-2021	$	4,375
Dec-2021	$	3,095
Feb-2021	$	2,360
Jan-2021	$	2,255
Jul-2021	$	3,980
Jun-2021	$	4,625
Mar-2021	$	2,345
May-2021	$	4,555
Nov-2021	$	3,425
Oct-2021	$	4,065
Sep-2021	$	4,095
[redacted]		
Apr-2021	$	1,908
Dec-2021	$	2,472
Jan-2021	$	1,064
Jul-2021	$	2,464
Jun-2021	$	1,808
Mar-2021	$	924
Nov-2021	$	1,388

Counterparty and Payment Dates		REC Cost
Sep-2021	$	3,016
[redacted]		
Apr-2021	$	3,170
Aug-2021	$	8,217
Dec-2021	$	6,691
Feb-2021	$	2,113
Jan-2021	$	3,404
Jul-2021	$	6,574
Jun-2021	$	7,043
Mar-2021	$	2,113
May-2021	$	3,756
Nov-2021	$	5,635
Oct-2021	$	7,630
Sep-2021	$	6,456
[redacted]		
Apr-2021	$	9,531
Aug-2021	$	19,638
Dec-2021	$	24,249
Feb-2021	$	8,166
Jan-2021	$	10,856
Jul-2021	$	18,446
Jun-2021	$	20,791
Mar-2021	$	8,839
May-2021	$	18,984
Nov-2021	$	18,908
Oct-2021	$	18,754
Sep-2021	$	21,137
[redacted]		
Apr-2021	$	1,835
Dec-2021	$	2,753
Feb-2021	$	1,502
Jan-2021	$	1,585
Mar-2021	$	1,585
[redacted]		
Apr-2021	$	1,526
Aug-2021	$	3,404
Dec-2021	$	4,109
Feb-2021	$	1,643
Jan-2021	$	1,761
Jul-2021	$	2,935
Jun-2021	$	3,052
Mar-2021	$	1,643
May-2021	$	3,170
Nov-2021	$	2,935
Oct-2021	$	2,817
Sep-2021	$	2,700
[redacted]		
Apr-2021	$	2,336
Aug-2021	$	2,676
Dec-2021	$	2,192
Feb-2021	$	1,556
Jan-2021	$	1,708
Jul-2021	$	2,688
Jun-2021	$	2,976
Mar-2021	$	1,596
May-2021	$	3,128
Nov-2021	$	2,284
Oct-2021	$	2,652
Sep-2021	$	2,632
[redacted]		

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Counterparty and Payment Dates		REC Cost
Apr-2021	$	2,202
Aug-2021	$	2,616
Dec-2021	$	2,070
Feb-2021	$	1,689
Jan-2021	$	1,761
Jul-2021	$	2,424
Jun-2021	$	2,778
Mar-2021	$	1,524
May-2021	$	2,901
Nov-2021	$	1,965
Oct-2021	$	2,256
Sep-2021	$	2,445
[redacted]		
Apr-2021	$	1,096
Aug-2021	$	1,308
Dec-2021	$	2,148
Feb-2021	$	720
Jan-2021	$	700
Jul-2021	$	1,152
Jun-2021	$	1,268
Mar-2021	$	788
May-2021	$	1,252
Nov-2021	$	1,072
Oct-2021	$	1,476
Sep-2021	$	1,072
[redacted]		
Apr-2021	$	2,812
Aug-2021	$	3,656
Dec-2021	$	2,800
Feb-2021	$	2,220
Jan-2021	$	2,272
Jul-2021	$	3,500
Jun-2021	$	3,868
Mar-2021	$	1,976
May-2021	$	3,972
Nov-2021	$	2,904
Oct-2021	$	3,380
Sep-2021	$	3,504
[redacted]		
Apr-2021	$	2,956
Aug-2021	$	3,460
Dec-2021	$	2,844
Feb-2021	$	2,196
Jan-2021	$	2,228
Jul-2021	$	2,756
Jun-2021	$	3,752
Mar-2021	$	2,024
May-2021	$	3,764
Nov-2021	$	2,924
Oct-2021	$	3,264
Sep-2021	$	3,312
[redacted]		
Apr-2021	$	2,376
Aug-2021	$	2,772
Dec-2021	$	2,166
Feb-2021	$	1,689
Jan-2021	$	1,719
Jul-2021	$	2,559
Jun-2021	$	2,835
Mar-2021	$	1,587

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May-2021	$	3,072
Nov-2021	$	2,289
Oct-2021	$	2,628
Sep-2021	$	2,301
[redacted]		
Apr-2021	$	-
Aug-2021	$	-
Dec-2021	$	-
Feb-2021	$	-
Jan-2021	$	-
Jul-2021	$	1,105
Jun-2021	$	-
Mar-2021	$	-
May-2021	$	-
Oct-2021	$	-
Sep-2021	$	-
[redacted]		
Apr-2021	$	2,689
Aug-2021	$	2,793
Dec-2021	$	1,655
Jan-2021	$	1,241
Jul-2021	$	3,103
Jun-2021	$	2,793
Mar-2021	$	1,551
May-2021	$	2,999
Nov-2021	$	1,758
Oct-2021	$	2,689
Sep-2021	$	2,586
[redacted]		
Feb-2021	$	34,579
Jan-2021	$	30,448
[redacted]		
Apr-2021	$	752
Aug-2021	$	920
Dec-2021	$	772
Feb-2021	$	564
Jan-2021	$	704
Jul-2021	$	1,012
Jun-2021	$	836
Mar-2021	$	532
May-2021	$	1,016
Nov-2021	$	768
Oct-2021	$	252
Sep-2021	$	832
[redacted]		
Apr-2021	$	43,556
Aug-2021	$	11,427
Dec-2021	$	44,032
Feb-2021	$	32,988
Jan-2021	$	34,980
Jul-2021	$	71,320
Jun-2021	$	58,224
Mar-2021	$	30,412
May-2021	$	58,736
Nov-2021	$	45,756
Oct-2021	$	20,889
Sep-2021	$	39,036
[redacted]		
Apr-2021	$	21,996
Aug-2021	$	26,920

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Counterparty and Payment Dates		REC Cost
Dec-2021	$	20,368
Feb-2021	$	17,064
Jan-2021	$	17,872
Jul-2021	$	25,416
Jun-2021	$	29,380
Mar-2021	$	15,444
May-2021	$	29,872
Nov-2021	$	19,588
Oct-2021	$	24,904
Sep-2021	$	25,096
[redacted]		
Apr-2021	$	2,632
Aug-2021	$	2,948
Dec-2021	$	2,600
Feb-2021	$	2,036
Jan-2021	$	2,164
Jul-2021	$	2,900
Jun-2021	$	3,548
Mar-2021	$	1,816
May-2021	$	3,664
Nov-2021	$	2,668
Oct-2021	$	3,144
Sep-2021	$	2,112
[redacted]		
Apr-2021	$	-
Aug-2021	$	-
Dec-2021	$	-
Feb-2021	$	-
Jan-2021	$	-
Jul-2021	$	-
Jun-2021	$	-
Mar-2021	$	-
May-2021	$	-
Nov-2021	$	-
Oct-2021	$	-
Sep-2021	$	-
[redacted]		
Apr-2021	$	2,568
Aug-2021	$	3,352
Dec-2021	$	2,516
Feb-2021	$	2,044
Jan-2021	$	2,144
Jul-2021	$	3,040
Jun-2021	$	3,440
Mar-2021	$	1,696
May-2021	$	3,696
Nov-2021	$	2,624
Oct-2021	$	3,112
Sep-2021	$	3,108
[redacted]		
Apr-2021	$	1,776
Dec-2021	$	1,724
Feb-2021	$	852
Jul-2021	$	1,772
Jun-2021	$	1,288
Mar-2021	$	672
Nov-2021	$	588
Sep-2021	$	1,464
[redacted]		
Apr-2021	$	796

Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		REC Cost
Dec-2021	$	952
Feb-2021	$	404
Jul-2021	$	1,120
Jun-2021	$	636
Mar-2021	$	316
Nov-2021	$	504
Sep-2021	$	1,152
[redacted]		
Apr-2021	$	788
Feb-2021	$	404
Jul-2021	$	1,116
Jun-2021	$	632
Mar-2021	$	308
Nov-2021	$	500
Sep-2021	$	1,168
[redacted]		
Apr-2021	$	2,756
Aug-2021	$	3,504
Dec-2021	$	2,720
Feb-2021	$	1,900
Jan-2021	$	2,052
Jul-2021	$	2,808
Jun-2021	$	3,624
Mar-2021	$	1,820
May-2021	$	3,628
Nov-2021	$	2,736
Oct-2021	$	3,308
Sep-2021	$	3,228
[redacted]		
Apr-2021	$	2,748
Aug-2021	$	3,500
Dec-2021	$	2,708
Feb-2021	$	2,048
Jan-2021	$	2,160
Jul-2021	$	3,232
Jun-2021	$	3,444
Mar-2021	$	1,924
May-2021	$	2,600
Nov-2021	$	2,812
Oct-2021	$	3,108
Sep-2021	$	3,240
[redacted]		
Apr-2021	$	235
Aug-2021	$	470
Feb-2021	$	117
Jan-2021	$	235
Jul-2021	$	235
Jun-2021	$	352
Mar-2021	$	117
May-2021	$	352
Nov-2021	$	235
Oct-2021	$	352
Sep-2021	$	235
[redacted]		
Apr-2021	$	388,407
Aug-2021	$	526,511
Feb-2021	$	469,608
Jan-2021	$	394,212
Jul-2021	$	475,772
Jun-2021	$	393,588

Counterparty and Payment Dates		REC Cost
Mar-2021	$	330,878
May-2021	$	467,375
Nov-2021	$	496,675
Oct-2021	$	470,412
Sep-2021	$	419,226
[redacted]		
Apr-2021	$	352
Aug-2021	$	352
Dec-2021	$	352
Feb-2021	$	235
Jan-2021	$	235
Jul-2021	$	470
Jun-2021	$	352
Mar-2021	$	117
May-2021	$	352
Nov-2021	$	352
Oct-2021	$	352
Sep-2021	$	352
[redacted]		
Apr-2021	$	235
Aug-2021	$	470
Dec-2021	$	470
Feb-2021	$	235
Jan-2021	$	117
Jul-2021	$	352
Jun-2021	$	352
Mar-2021	$	235
May-2021	$	352
Nov-2021	$	352
Oct-2021	$	352
Sep-2021	$	352
[redacted]		
Apr-2021	$	2,916
Aug-2021	$	3,748
Dec-2021	$	2,840
Feb-2021	$	2,048
Jan-2021	$	2,172
Jul-2021	$	3,428
Jun-2021	$	3,792
Mar-2021	$	2,000
May-2021	$	3,132
Nov-2021	$	2,940
Oct-2021	$	3,364
Sep-2021	$	3,508
[redacted]		
Apr-2021	$	579
Aug-2021	$	843
Dec-2021	$	675
Feb-2021	$	612
Jan-2021	$	756
Jul-2021	$	855
Jun-2021	$	1,035
Mar-2021	$	636
May-2021	$	849
Nov-2021	$	1,032
Oct-2021	$	936
Sep-2021	$	1,044
[redacted]		
Apr-2021	$	2,940
Aug-2021	$	3,645

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Dec-2021	$	2,755
Feb-2021	$	2,015
Jan-2021	$	2,205
Jul-2021	$	3,455
Jun-2021	$	3,865
Mar-2021	$	1,865
May-2021	$	4,115
Nov-2021	$	2,890
Oct-2021	$	3,360
Sep-2021	$	3,435
[redacted]		
Apr-2021	$	1,628
Aug-2021	$	1,872
Dec-2021	$	1,240
Feb-2021	$	992
Jan-2021	$	1,040
Jul-2021	$	1,852
Jun-2021	$	1,912
Mar-2021	$	956
May-2021	$	2,144
Nov-2021	$	1,472
Oct-2021	$	1,728
Sep-2021	$	1,864
[redacted]		
Apr-2021	$	3,525
Aug-2021	$	4,345
Dec-2021	$	3,280
Feb-2021	$	2,620
Jan-2021	$	2,615
Jul-2021	$	3,895
Jun-2021	$	4,595
Mar-2021	$	2,385
May-2021	$	4,695
Nov-2021	$	3,480
Oct-2021	$	4,030
Sep-2021	$	4,115
[redacted]		
Apr-2021	$	455
Aug-2021	$	873
Dec-2021	$	1,343
Feb-2021	$	470
Jan-2021	$	612
Jul-2021	$	767
Jun-2021	$	826
Mar-2021	$	502
May-2021	$	740
Nov-2021	$	635
Oct-2021	$	932
Sep-2021	$	722
[redacted]		
Apr-2021	$	2,888
Aug-2021	$	1,356
Dec-2021	$	2,840
Feb-2021	$	2,212
Jan-2021	$	1,564
Jul-2021	$	3,468
Jun-2021	$	3,932
Mar-2021	$	2,000
May-2021	$	3,992
Nov-2021	$	2,800

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Counterparty and Payment Dates		REC Cost
Oct-2021	$	3,368
Sep-2021	$	3,448
[redacted]		
Apr-2021	$	117
Aug-2021	$	117
Feb-2021	$	117
Jul-2021	$	117
May-2021	$	117
Nov-2021	$	117
Oct-2021	$	117
Sep-2021	$	117
[redacted]		
Apr-2021	$	73
Aug-2021	$	147
Jan-2021	$	73
Jul-2021	$	73
Jun-2021	$	147
Mar-2021	$	73
May-2021	$	73
Nov-2021	$	73
Oct-2021	$	147
Sep-2021	$	73
[redacted]		
Apr-2021	$	2,860
Aug-2021	$	1,272
Dec-2021	$	2,752
Feb-2021	$	1,940
Jan-2021	$	2,076
Jul-2021	$	3,372
Jun-2021	$	3,692
Mar-2021	$	1,944
May-2021	$	3,812
Nov-2021	$	2,884
Oct-2021	$	3,376
Sep-2021	$	3,448
[redacted]		
Apr-2021	$	2,415
Aug-2021	$	1,865
Dec-2021	$	3,105
Feb-2021	$	1,245
Jan-2021	$	1,435
Jul-2021	$	1,935
Mar-2021	$	970
May-2021	$	2,000
Nov-2021	$	1,925
Sep-2021	$	3,610
[redacted]		
Apr-2021	$	89,185
Aug-2021	$	168,164
Feb-2021	$	85,388
Jul-2021	$	155,277
Jun-2021	$	119,679
Mar-2021	$	10,973
Nov-2021	$	169,057
Oct-2021	$	167,270
Sep-2021	$	147,494
[redacted]		
Apr-2021	$	1,557
Aug-2021	$	1,854
Dec-2021	$	1,528

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Feb-2021	$	1,116
Jan-2021	$	1,159
Jul-2021	$	1,667
Jun-2021	$	1,955
Mar-2021	$	1,055
May-2021	$	2,023
Nov-2021	$	1,476
Oct-2021	$	1,739
Sep-2021	$	1,764
[redacted]		
Apr-2021	$	1,530
Aug-2021	$	1,800
Dec-2021	$	1,289
Feb-2021	$	1,116
Jan-2021	$	887
Jul-2021	$	1,622
Jun-2021	$	1,937
Mar-2021	$	1,040
May-2021	$	2,003
Nov-2021	$	1,429
Oct-2021	$	1,652
Sep-2021	$	1,690
[redacted]		
Apr-2021	$	103
Aug-2021	$	103
Dec-2021	$	103
Jan-2021	$	103
Jul-2021	$	207
Jun-2021	$	103
Mar-2021	$	103
May-2021	$	103
Oct-2021	$	207
Sep-2021	$	103
[redacted]		
Apr-2021	$	207
Aug-2021	$	310
Dec-2021	$	414
Feb-2021	$	207
Jan-2021	$	207
Jul-2021	$	310
Jun-2021	$	310
Mar-2021	$	103
May-2021	$	207
Nov-2021	$	103
Oct-2021	$	310
Sep-2021	$	207
[redacted]		
Apr-2021	$	73
Dec-2021	$	147
Feb-2021	$	73
Jul-2021	$	220
Jun-2021	$	147
Sep-2021	$	73
[redacted]		
Apr-2021	$	2,856
Aug-2021	$	3,712
Dec-2021	$	2,908
Feb-2021	$	2,264
Jan-2021	$	2,364
Jul-2021	$	3,600

Counterparty and Payment Dates		REC Cost
Jun-2021	$	3,980
Mar-2021	$	2,008
May-2021	$	4,140
Nov-2021	$	3,064
Oct-2021	$	3,496
Sep-2021	$	3,536
[redacted]		
Aug-2021	$	147
Feb-2021	$	73
Jan-2021	$	73
Jul-2021	$	147
Jun-2021	$	73
Mar-2021	$	73
May-2021	$	147
Nov-2021	$	73
Oct-2021	$	147
Sep-2021	$	73
[redacted]		
Apr-2021	$	2,830
Aug-2021	$	4,275
Dec-2021	$	3,450
Feb-2021	$	2,575
Jan-2021	$	2,750
Jul-2021	$	3,880
Jun-2021	$	4,665
Mar-2021	$	2,215
May-2021	$	4,440
Nov-2021	$	3,465
Oct-2021	$	4,105
Sep-2021	$	4,140
[redacted]		
Apr-2021	$	2,876
Aug-2021	$	3,136
Dec-2021	$	2,964
Feb-2021	$	2,272
Jan-2021	$	2,412
Jul-2021	$	3,268
Jun-2021	$	4,024
Mar-2021	$	2,008
May-2021	$	3,880
Nov-2021	$	3,108
Oct-2021	$	3,608
Sep-2021	$	3,100
[redacted]		
Apr-2021	$	1,584
Aug-2021	$	1,985
Dec-2021	$	1,746
Feb-2021	$	1,222
Jan-2021	$	1,112
Jul-2021	$	1,532
Jun-2021	$	1,955
Mar-2021	$	1,118
May-2021	$	2,214
Nov-2021	$	1,690
Oct-2021	$	1,859
Sep-2021	$	1,825
[redacted]		
Apr-2021	$	3,425
Aug-2021	$	4,240
Dec-2021	$	3,305

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Feb-2021	$	2,165
Jan-2021	$	2,440
Jul-2021	$	4,070
Jun-2021	$	4,410
Mar-2021	$	2,295
May-2021	$	4,535
Nov-2021	$	3,250
Oct-2021	$	3,625
Sep-2021	$	4,140
[redacted]		
Apr-2021	$	3,000
Aug-2021	$	4,375
Dec-2021	$	3,400
Feb-2021	$	2,520
Jan-2021	$	2,675
Jul-2021	$	4,255
Jun-2021	$	4,275
Mar-2021	$	2,385
May-2021	$	4,905
Nov-2021	$	3,335
Oct-2021	$	3,870
Sep-2021	$	4,310
[redacted]		
Apr-2021	$	17,876
Aug-2021	$	22,765
Dec-2021	$	18,050
Feb-2021	$	13,346
Jan-2021	$	14,152
Jul-2021	$	21,547
Jun-2021	$	23,183
Mar-2021	$	12,296
May-2021	$	24,053
Nov-2021	$	18,021
Oct-2021	$	19,181
Sep-2021	$	21,437
[redacted]		
Apr-2021	$	2,964
Aug-2021	$	3,592
Dec-2021	$	2,744
Feb-2021	$	2,016
Jan-2021	$	2,140
Jul-2021	$	3,408
Jun-2021	$	3,708
Mar-2021	$	1,852
May-2021	$	3,972
Nov-2021	$	2,692
Oct-2021	$	3,312
Sep-2021	$	3,452
[redacted]		
Apr-2021	$	5,922
Aug-2021	$	11,188
Dec-2021	$	11,679
Feb-2021	$	3,360
Jan-2021	$	3,274
Jul-2021	$	9,282
Jun-2021	$	9,036
Mar-2021	$	10,347
May-2021	$	2,274
Nov-2021	$	16,576
Oct-2021	$	15,675

Counterparty and Payment Dates		REC Cost
Sep-2021	$	16,126
[redacted]		
Apr-2021	$	3,800
Aug-2021	$	5,035
Dec-2021	$	3,760
Feb-2021	$	2,845
Jan-2021	$	2,985
Jul-2021	$	4,565
Jun-2021	$	5,045
Mar-2021	$	2,540
May-2021	$	5,060
Nov-2021	$	2,375
Oct-2021	$	4,560
Sep-2021	$	4,785
[redacted]		
Apr-2021	$	3,570
Aug-2021	$	4,420
Dec-2021	$	3,470
Feb-2021	$	2,480
Jan-2021	$	2,735
Jul-2021	$	4,170
Jun-2021	$	4,675
Mar-2021	$	2,440
May-2021	$	4,820
Nov-2021	$	2,155
Oct-2021	$	4,100
Sep-2021	$	4,245
[redacted]		
Apr-2021	$	2,870
Aug-2021	$	3,510
Dec-2021	$	2,455
Feb-2021	$	1,925
Jan-2021	$	1,990
Jul-2021	$	3,305
Jun-2021	$	3,580
Mar-2021	$	1,955
May-2021	$	3,920
Nov-2021	$	2,620
Oct-2021	$	580
Sep-2021	$	3,230
[redacted]		
Apr-2021	$	3,010
Aug-2021	$	3,720
Dec-2021	$	5,640
Feb-2021	$	1,910
Jan-2021	$	1,995
Jul-2021	$	3,245
Jun-2021	$	3,750
Mar-2021	$	1,970
May-2021	$	3,680
Oct-2021	$	3,380
Sep-2021	$	3,460
[redacted]		
Apr-2021	$	3,160
Aug-2021	$	3,936
Dec-2021	$	2,744
Feb-2021	$	1,952
Jan-2021	$	2,024
Jul-2021	$	3,388
Jun-2021	$	4,016

Counterparty and Payment Dates		REC Cost
Mar-2021	$	2,080
May-2021	$	4,216
Nov-2021	$	2,864
Oct-2021	$	3,404
Sep-2021	$	3,684
[redacted]		
Apr-2021	$	832
Aug-2021	$	1,528
Feb-2021	$	784
Jan-2021	$	1,120
Jul-2021	$	1,052
Jun-2021	$	1,324
Mar-2021	$	688
May-2021	$	1,440
Nov-2021	$	1,284
Oct-2021	$	1,492
Sep-2021	$	1,248
[redacted]		
Apr-2021	$	965
Aug-2021	$	270
Feb-2021	$	855
Jul-2021	$	295
Jun-2021	$	155
Mar-2021	$	1,005
May-2021	$	780
Sep-2021	$	5
[redacted]		
Apr-2021	$	11,387
Aug-2021	$	17,139
Dec-2021	$	12,091
Feb-2021	$	7,983
Jan-2021	$	9,743
Jul-2021	$	14,909
Jun-2021	$	15,848
Mar-2021	$	8,569
May-2021	$	16,435
Nov-2021	$	13,735
Oct-2021	$	17,609
Sep-2021	$	14,791
[redacted]		
Apr-2021	$	3,575
Aug-2021	$	3,440
Dec-2021	$	2,760
Feb-2021	$	2,590
Jan-2021	$	2,240
Jul-2021	$	3,835
Jun-2021	$	3,615
Mar-2021	$	2,505
May-2021	$	3,935
Nov-2021	$	2,840
Oct-2021	$	3,320
Sep-2021	$	3,395
[redacted]		
Apr-2021	$	16,069
Dec-2021	$	30,835
Jan-2021	$	9,077
Jul-2021	$	24,451
Jun-2021	$	14,245
Mar-2021	$	7,340
Sep-2021	$	23,713

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Counterparty and Payment Dates		**REC Cost**
[redacted]		
Apr-2021	$	916
Aug-2021	$	682
Dec-2021	$	578
Feb-2021	$	428
Jan-2021	$	511
Jul-2021	$	749
Jun-2021	$	826
Mar-2021	$	385
Nov-2021	$	729
Sep-2021	$	1,402
[redacted]		
Apr-2021	$	1,546
Aug-2021	$	1,699
Dec-2021	$	1,636
Feb-2021	$	1,226
Jan-2021	$	1,224
Jul-2021	$	1,744
Jun-2021	$	1,996
Mar-2021	$	1,089
May-2021	$	2,140
Nov-2021	$	1,564
Oct-2021	$	1,517
Sep-2021	$	1,580
[redacted]		
Apr-2021	$	3,140
Aug-2021	$	3,892
Dec-2021	$	2,916
Feb-2021	$	2,080
Jan-2021	$	2,204
Jul-2021	$	3,644
Jun-2021	$	3,928
Mar-2021	$	1,996
May-2021	$	4,080
Nov-2021	$	2,696
Oct-2021	$	3,444
Sep-2021	$	3,748
[redacted]		
Apr-2021	$	3,390
Aug-2021	$	4,115
Dec-2021	$	3,430
Feb-2021	$	2,775
Jan-2021	$	2,835
Jul-2021	$	3,750
Jun-2021	$	4,250
Mar-2021	$	2,420
May-2021	$	4,560
Nov-2021	$	3,385
Oct-2021	$	3,795
Sep-2021	$	3,815
[redacted]		
Apr-2021	$	2,610
Jun-2021	$	7,009
May-2021	$	151
[redacted]		
Sep-2021	$	468,483
[redacted]		
Apr-2021	$	1,559
Aug-2021	$	1,994
Dec-2021	$	1,573

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Feb-2021	$	1,213
Jan-2021	$	1,271
Jul-2021	$	1,791
Jun-2021	$	2,057
Mar-2021	$	1,051
May-2021	$	2,147
Oct-2021	$	1,809
Sep-2021	$	1,834
[redacted]		
Apr-2021	$	12,218
Aug-2021	$	14,468
Dec-2021	$	11,253
Feb-2021	$	8,199
Jan-2021	$	8,533
Jul-2021	$	14,147
Jun-2021	$	14,147
Mar-2021	$	7,797
May-2021	$	15,996
Nov-2021	$	10,932
Oct-2021	$	12,941
Sep-2021	$	14,388
[redacted]		
Apr-2021	$	7,643
Aug-2021	$	15,287
Dec-2021	$	21,450
Feb-2021	$	8,156
Jan-2021	$	8,951
Jul-2021	$	13,083
Jun-2021	$	13,324
Mar-2021	$	7,919
May-2021	$	12,636
Nov-2021	$	9,640
Oct-2021	$	11,947
Sep-2021	$	12,911
[redacted]		
Aug-2021	$	2,075
Dec-2021	$	1,508
Jul-2021	$	2,291
Nov-2021	$	1,222
Oct-2021	$	1,535
Sep-2021	$	1,802
[redacted]		
Apr-2021	$	3,115
Aug-2021	$	3,995
Dec-2021	$	2,855
Feb-2021	$	2,395
Jan-2021	$	2,470
Jul-2021	$	3,720
Jun-2021	$	4,325
Mar-2021	$	1,690
May-2021	$	2,190
Nov-2021	$	3,145
Oct-2021	$	3,600
Sep-2021	$	3,610
[redacted]		
Apr-2021	$	4,700
Aug-2021	$	5,287
Dec-2021	$	8,224
Feb-2021	$	2,276
Jan-2021	$	2,056

Counterparty and Payment Dates		REC Cost
Jul-2021	$	4,259
Jun-2021	$	4,700
May-2021	$	4,406
Oct-2021	$	4,112
Sep-2021	$	3,892
[redacted]		
Apr-2021	$	2,144
Aug-2021	$	2,732
Dec-2021	$	2,168
Feb-2021	$	1,748
Jan-2021	$	1,788
Jul-2021	$	2,556
Jun-2021	$	2,856
Mar-2021	$	1,600
May-2021	$	3,032
Nov-2021	$	2,272
Oct-2021	$	2,568
Sep-2021	$	1,984
[redacted]		
Apr-2021	$	3,390
Aug-2021	$	4,145
Dec-2021	$	3,285
Feb-2021	$	2,745
Jan-2021	$	2,775
Jul-2021	$	3,845
Jun-2021	$	3,870
Mar-2021	$	2,450
May-2021	$	4,575
Nov-2021	$	3,360
Oct-2021	$	3,895
Sep-2021	$	3,985
[redacted]		
Apr-2021	$	1,600
Aug-2021	$	1,925
Dec-2021	$	1,593
Feb-2021	$	1,288
Jan-2021	$	1,318
Jul-2021	$	1,805
Jun-2021	$	2,048
Mar-2021	$	1,135
May-2021	$	2,200
Nov-2021	$	1,570
Oct-2021	$	1,748
Sep-2021	$	1,780
[redacted]		
Apr-2021	$	3,560
Aug-2021	$	4,825
Dec-2021	$	3,635
Feb-2021	$	2,760
Jan-2021	$	2,920
Jul-2021	$	4,395
Jun-2021	$	4,990
Mar-2021	$	2,460
May-2021	$	5,020
Nov-2021	$	3,485
Oct-2021	$	4,375
Sep-2021	$	4,465
[redacted]		
Apr-2021	$	942
Aug-2021	$	1,178

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Dec-2021	$	917
Feb-2021	$	700
Jan-2021	$	747
Jul-2021	$	908
Jun-2021	$	1,260
Mar-2021	$	600
May-2021	$	1,332
Nov-2021	$	950
Oct-2021	$	1,101
Sep-2021	$	1,122
[redacted]		
Apr-2021	$	3,730
Aug-2021	$	4,240
Dec-2021	$	3,350
Feb-2021	$	2,235
Jan-2021	$	2,265
Jul-2021	$	3,970
Jun-2021	$	4,340
Mar-2021	$	2,280
May-2021	$	4,225
Nov-2021	$	3,330
Oct-2021	$	3,960
Sep-2021	$	4,230
[redacted]		
Apr-2021	$	1,220
Aug-2021	$	1,720
Dec-2021	$	2,308
Feb-2021	$	984
Jan-2021	$	864
Jul-2021	$	1,384
Jun-2021	$	1,520
Mar-2021	$	744
May-2021	$	1,600
Nov-2021	$	1,168
Oct-2021	$	1,696
Sep-2021	$	1,420
[redacted]		
Apr-2021	$	7,757
Aug-2021	$	6,102
Dec-2021	$	8,585
Jan-2021	$	4,137
Jul-2021	$	6,413
Jun-2021	$	6,206
Mar-2021	$	2,482
May-2021	$	7,240
Oct-2021	$	6,102
Sep-2021	$	6,309
[redacted]		
Apr-2021	$	2,113
Aug-2021	$	2,700
Dec-2021	$	1,761
Feb-2021	$	1,291
Jan-2021	$	1,409
Jul-2021	$	2,465
Jun-2021	$	2,817
Mar-2021	$	1,409
May-2021	$	2,817
Nov-2021	$	1,878
Oct-2021	$	2,348
Sep-2021	$	2,348

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[redacted]		
Apr-2021	$	3,000
Aug-2021	$	3,520
Dec-2021	$	3,156
Feb-2021	$	2,488
Jan-2021	$	2,572
Jul-2021	$	3,444
Jun-2021	$	3,804
Mar-2021	$	2,092
May-2021	$	4,028
Nov-2021	$	2,640
Oct-2021	$	3,288
Sep-2021	$	3,408
[redacted]		
Apr-2021	$	3,670
Aug-2021	$	4,525
Dec-2021	$	3,455
Feb-2021	$	2,690
Jan-2021	$	2,810
Jul-2021	$	4,325
Jun-2021	$	4,760
Mar-2021	$	2,570
May-2021	$	4,975
Nov-2021	$	3,680
Oct-2021	$	4,225
Sep-2021	$	4,205
[redacted]		
Apr-2021	$	3,520
Aug-2021	$	3,965
Dec-2021	$	3,545
Feb-2021	$	2,530
Jan-2021	$	2,785
Jul-2021	$	3,890
Jun-2021	$	4,450
Mar-2021	$	2,250
May-2021	$	4,775
Nov-2021	$	3,275
Oct-2021	$	3,995
Sep-2021	$	3,980
[redacted]		
Apr-2021	$	1,020
Aug-2021	$	1,664
Dec-2021	$	2,372
Feb-2021	$	872
Jan-2021	$	1,040
Jul-2021	$	1,420
Jun-2021	$	1,504
Mar-2021	$	928
May-2021	$	1,360
Nov-2021	$	1,184
Oct-2021	$	1,708
Sep-2021	$	1,380
[redacted]		
Apr-2021	$	5,951
Aug-2021	$	7,561
Dec-2021	$	13,063
Feb-2021	$	4,288
Jan-2021	$	5,612
Jul-2021	$	6,812
Jun-2021	$	7,187

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Mar-2021	$	4,492
May-2021	$	6,999
Nov-2021	$	5,914
Oct-2021	$	7,898
Sep-2021	$	6,475
[redacted]		
Apr-2021	$	3,700
Aug-2021	$	4,250
Dec-2021	$	3,080
Feb-2021	$	2,155
Jan-2021	$	2,155
Jul-2021	$	3,720
Jun-2021	$	4,290
Mar-2021	$	2,320
Nov-2021	$	3,250
Oct-2021	$	3,945
Sep-2021	$	4,075
[redacted]		
May-2021	$	195
[redacted]		
May-2021	$	105
[redacted]		
Apr-2021	$	441
Aug-2021	$	1,049
Jun-2021	$	808
Mar-2021	$	294
May-2021	$	808
Nov-2021	$	175
Oct-2021	$	262
Sep-2021	$	787
[redacted]		
Apr-2021	$	1,433
Aug-2021	$	1,881
Dec-2021	$	1,517
Feb-2021	$	1,168
Jan-2021	$	1,222
Jul-2021	$	1,526
Jun-2021	$	1,897
Mar-2021	$	990
May-2021	$	2,009
Nov-2021	$	1,499
Oct-2021	$	1,757
Sep-2021	$	1,575
[redacted]		
Apr-2021	$	547
Aug-2021	$	864
Dec-2021	$	632
Feb-2021	$	470
Jan-2021	$	585
Jul-2021	$	758
Jun-2021	$	830
Mar-2021	$	545
May-2021	$	781
Nov-2021	$	738
Oct-2021	$	860
Sep-2021	$	729
[redacted]		
Apr-2021	$	3,206
Aug-2021	$	5,482
Dec-2021	$	6,826

Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		REC Cost
Feb-2021	$	2,586
Jan-2021	$	2,793
Jul-2021	$	4,758
Jun-2021	$	5,275
Mar-2021	$	2,689
May-2021	$	5,068
Nov-2021	$	4,034
Oct-2021	$	5,068
Sep-2021	$	4,965
[redacted]		
Apr-2021	$	1,629
Aug-2021	$	1,942
Dec-2021	$	1,609
Feb-2021	$	1,224
Jan-2021	$	1,258
Jul-2021	$	1,834
Jun-2021	$	2,066
Mar-2021	$	1,148
May-2021	$	2,156
Nov-2021	$	1,654
Oct-2021	$	1,861
Sep-2021	$	1,877
[redacted]		
Apr-2021	$	3,440
Aug-2021	$	4,365
Dec-2021	$	3,290
Feb-2021	$	2,640
Jan-2021	$	2,795
Jul-2021	$	4,055
Jun-2021	$	4,445
Mar-2021	$	2,390
May-2021	$	4,895
Nov-2021	$	3,560
Oct-2021	$	4,070
Sep-2021	$	4,090
[redacted]		
Apr-2021	$	3,016
Aug-2021	$	3,896
Dec-2021	$	2,848
Feb-2021	$	2,176
Jan-2021	$	2,268
Jul-2021	$	3,740
Jun-2021	$	4,020
Mar-2021	$	2,104
May-2021	$	4,136
Nov-2021	$	3,076
Oct-2021	$	2,652
Sep-2021	$	3,808
[redacted]		
Apr-2021	$	3,116
Aug-2021	$	3,940
Dec-2021	$	2,292
Feb-2021	$	2,312
Jan-2021	$	2,364
Jul-2021	$	3,256
Jun-2021	$	3,960
Mar-2021	$	2,092
May-2021	$	3,728
Nov-2021	$	3,096
Oct-2021	$	3,524

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Sep-2021	$	3,584
[redacted]		
Apr-2021	$	2,345
Aug-2021	$	2,630
Dec-2021	$	2,095
Feb-2021	$	1,400
Jan-2021	$	1,565
Jul-2021	$	2,370
Jun-2021	$	2,810
Mar-2021	$	1,490
May-2021	$	3,030
Nov-2021	$	2,050
Oct-2021	$	2,495
Sep-2021	$	2,650
[redacted]		
Apr-2021	$	3,305
Aug-2021	$	3,990
Dec-2021	$	3,310
Feb-2021	$	2,505
Jan-2021	$	2,590
Jul-2021	$	3,630
Jun-2021	$	4,375
Mar-2021	$	2,230
May-2021	$	4,565
Oct-2021	$	3,830
Sep-2021	$	3,760
[redacted]		
Apr-2021	$	3,410
Aug-2021	$	4,615
Dec-2021	$	6,905
Feb-2021	$	2,540
Jan-2021	$	2,630
Jul-2021	$	4,425
Jun-2021	$	4,500
Mar-2021	$	2,350
May-2021	$	4,680
Oct-2021	$	4,205
Sep-2021	$	4,450
[redacted]		
Apr-2021	$	3,510
Aug-2021	$	4,375
Dec-2021	$	3,350
Feb-2021	$	2,355
Jan-2021	$	2,560
Jul-2021	$	4,195
Jun-2021	$	4,470
Mar-2021	$	2,315
May-2021	$	4,830
Nov-2021	$	3,345
Oct-2021	$	4,000
Sep-2021	$	4,350
[redacted]		
Aug-2021	$	40,615
Feb-2021	$	69,185
Jul-2021	$	25,480
Jun-2021	$	7,535
Mar-2021	$	6,690
Nov-2021	$	47,310
Oct-2021	$	49,015
Sep-2021	$	38,940

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[redacted]		
Apr-2021	$	3,048
Aug-2021	$	3,492
Dec-2021	$	2,596
Feb-2021	$	1,848
Jan-2021	$	1,812
Jul-2021	$	3,388
Jun-2021	$	3,668
Mar-2021	$	1,784
May-2021	$	3,852
Nov-2021	$	2,700
Oct-2021	$	3,252
Sep-2021	$	3,464
[redacted]		
Apr-2021	$	3,920
Aug-2021	$	4,355
Dec-2021	$	3,585
Feb-2021	$	2,390
Jan-2021	$	2,760
Jul-2021	$	3,700
Jun-2021	$	4,505
Mar-2021	$	2,410
May-2021	$	4,940
Nov-2021	$	3,465
Oct-2021	$	4,055
Sep-2021	$	4,180
[redacted]		
Apr-2021	$	3,625
Aug-2021	$	4,260
Dec-2021	$	3,160
Feb-2021	$	2,690
Jan-2021	$	2,975
Jul-2021	$	3,990
Jun-2021	$	4,755
Mar-2021	$	2,455
May-2021	$	4,865
Nov-2021	$	3,705
Oct-2021	$	4,065
Sep-2021	$	3,940
[redacted]		
Apr-2021	$	24,379
Aug-2021	$	36,786
Dec-2021	$	13,278
Feb-2021	$	18,284
Jan-2021	$	16,974
Jul-2021	$	33,521
Jun-2021	$	42,881
Mar-2021	$	17,626
May-2021	$	45,493
Nov-2021	$	10,666
Oct-2021	$	25,467
Sep-2021	$	16,978
[redacted]		
Apr-2021	$	3,195
Aug-2021	$	3,760
Dec-2021	$	3,275
Feb-2021	$	2,615
Jan-2021	$	2,745
Jul-2021	$	3,580
Jun-2021	$	4,115

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Counterparty and Payment Dates		REC Cost
Mar-2021	$	2,365
May-2021	$	4,530
Nov-2021	$	3,450
Oct-2021	$	3,845
Sep-2021	$	3,725
[redacted]		
Apr-2021	$	2,113
Aug-2021	$	3,991
Dec-2021	$	3,522
Feb-2021	$	1,174
Jan-2021	$	1,761
Jul-2021	$	3,170
Jun-2021	$	3,404
Mar-2021	$	1,526
May-2021	$	3,170
Nov-2021	$	2,113
Oct-2021	$	2,935
Sep-2021	$	3,170
[redacted]		
Apr-2021	$	3,835
Aug-2021	$	4,655
Dec-2021	$	3,665
Feb-2021	$	2,815
Jan-2021	$	2,955
Jul-2021	$	4,980
Jun-2021	$	4,700
Mar-2021	$	2,400
May-2021	$	5,085
Nov-2021	$	3,555
Oct-2021	$	2,550
Sep-2021	$	3,755
[redacted]		
Dec-2021	$	972
Jul-2021	$	5,139
Nov-2021	$	797
Oct-2021	$	1,208
Sep-2021	$	1,384
[redacted]		
Apr-2021	$	2,856
Aug-2021	$	3,536
Dec-2021	$	2,744
Feb-2021	$	2,080
Jan-2021	$	2,196
Jul-2021	$	3,328
Jun-2021	$	3,640
Mar-2021	$	2,044
May-2021	$	3,896
Nov-2021	$	2,804
Oct-2021	$	3,180
Sep-2021	$	3,320
[redacted]		
Apr-2021	$	235
Aug-2021	$	352
Dec-2021	$	470
Feb-2021	$	235
Jan-2021	$	235
Jul-2021	$	352
Jun-2021	$	352
Mar-2021	$	235
May-2021	$	235

Counterparty and Payment Dates		REC Cost
Nov-2021	$	352
Oct-2021	$	352
Sep-2021	$	235
[redacted]		
Apr-2021	$	117
Aug-2021	$	117
Dec-2021	$	117
Feb-2021	$	117
Jan-2021	$	235
Jul-2021	$	235
Jun-2021	$	117
Mar-2021	$	117
May-2021	$	235
Nov-2021	$	117
Oct-2021	$	352
Sep-2021	$	117
[redacted]		
Apr-2021	$	4,447
Aug-2021	$	6,413
Dec-2021	$	5,999
Feb-2021	$	3,413
Jan-2021	$	3,517
Jul-2021	$	5,585
Jun-2021	$	6,206
Mar-2021	$	2,689
May-2021	$	5,378
Nov-2021	$	3,827
Oct-2021	$	5,482
Sep-2021	$	5,068
[redacted]		
Apr-2021	$	11,575
Aug-2021	$	14,697
Dec-2021	$	11,351
Feb-2021	$	7,694
Jan-2021	$	9,160
Jul-2021	$	13,576
Jun-2021	$	15,629
Mar-2021	$	7,659
May-2021	$	16,336
Nov-2021	$	11,713
Oct-2021	$	13,697
Sep-2021	$	13,766
[redacted]		
Apr-2021	$	2,240
Aug-2021	$	2,588
Dec-2021	$	1,932
Feb-2021	$	1,560
Jan-2021	$	1,392
Jul-2021	$	2,384
Jun-2021	$	2,584
Mar-2021	$	1,412
May-2021	$	2,808
Nov-2021	$	2,032
Oct-2021	$	2,128
Sep-2021	$	2,296
[redacted]		
Apr-2021	$	3,635
Aug-2021	$	4,450
Dec-2021	$	3,435
Feb-2021	$	2,635

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Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		**REC Cost**
Jan-2021	$	2,680
Jul-2021	$	4,090
Jun-2021	$	4,720
Mar-2021	$	2,450
May-2021	$	4,885
Nov-2021	$	3,555
Oct-2021	$	4,090
Sep-2021	$	4,160
[redacted]		
Apr-2021	$	3,445
Aug-2021	$	4,430
Dec-2021	$	3,475
Feb-2021	$	2,705
Jan-2021	$	2,785
Jul-2021	$	4,040
Jun-2021	$	4,530
Mar-2021	$	2,390
May-2021	$	4,885
Nov-2021	$	3,450
Oct-2021	$	4,065
Sep-2021	$	3,995
[redacted]		
Apr-2021	$	98,543
Aug-2021	$	89,393
Dec-2021	$	84,846
Feb-2021	$	100,201
Jan-2021	$	105,992
Jul-2021	$	82,783
Jun-2021	$	89,952
Mar-2021	$	94,840
May-2021	$	89,672
Nov-2021	$	93,393
Oct-2021	$	90,575
Sep-2021	$	88,150
[redacted]		
Apr-2021	$	2,796
Aug-2021	$	3,700
Dec-2021	$	5,304
Feb-2021	$	1,652
Jan-2021	$	1,800
Jul-2021	$	3,508
Jun-2021	$	3,752
Mar-2021	$	1,816
May-2021	$	4,048
Oct-2021	$	3,324
Sep-2021	$	3,680
[redacted]		
Apr-2021	$	1,445
Aug-2021	$	1,945
Dec-2021	$	2,845
Feb-2021	$	1,175
Jan-2021	$	1,210
Jul-2021	$	1,720
Jun-2021	$	1,720
Mar-2021	$	930
May-2021	$	1,900
Nov-2021	$	1,295
Oct-2021	$	1,795
Sep-2021	$	1,850
[redacted]		

Counterparty and Payment Dates		REC Cost
Apr-2021	$	3,820
Aug-2021	$	4,415
Dec-2021	$	6,915
Feb-2021	$	2,320
Jan-2021	$	2,525
Jul-2021	$	4,005
Jun-2021	$	4,575
Mar-2021	$	2,420
May-2021	$	4,880
Oct-2021	$	4,130
Sep-2021	$	4,400
[redacted]		
Mar-2021	$	493,850
[redacted]		
Apr-2021	$	3,435
Aug-2021	$	4,205
Dec-2021	$	7,730
Feb-2021	$	2,745
Jan-2021	$	2,830
Jul-2021	$	3,860
Jun-2021	$	4,145
Mar-2021	$	2,385
May-2021	$	4,400
Oct-2021	$	4,170
Sep-2021	$	4,320
[redacted]		
Apr-2021	$	2,932
Aug-2021	$	3,784
Dec-2021	$	5,876
Feb-2021	$	2,216
Jan-2021	$	2,312
Jul-2021	$	3,588
Jun-2021	$	3,888
Mar-2021	$	1,976
May-2021	$	3,972
Oct-2021	$	3,252
Sep-2021	$	3,568
[redacted]		
Apr-2021	$	2,940
Aug-2021	$	3,924
Dec-2021	$	6,092
Feb-2021	$	2,256
Jan-2021	$	2,352
Jul-2021	$	3,608
Jun-2021	$	3,944
Mar-2021	$	2,008
May-2021	$	4,020
Oct-2021	$	3,396
Sep-2021	$	3,696
[redacted]		
Apr-2021	$	3,825
Aug-2021	$	4,260
Dec-2021	$	7,055
Feb-2021	$	2,640
Jan-2021	$	2,835
Jul-2021	$	4,095
Jun-2021	$	4,200
Mar-2021	$	2,460
May-2021	$	4,735
Oct-2021	$	3,860

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Docket No. E-2, Sub 1293 **Presson Exhibit 1, Appendix 2**
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Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		REC Cost
Sep-2021	$	4,265
[redacted]		
Apr-2021	$	2,350
Aug-2021	$	4,259
Dec-2021	$	5,360
Feb-2021	$	1,762
Jan-2021	$	2,056
Jul-2021	$	1,542
Jun-2021	$	3,965
Mar-2021	$	2,129
May-2021	$	3,304
Nov-2021	$	3,084
Oct-2021	$	4,112
Sep-2021	$	3,525
[redacted]		
Apr-2021	$	1,658
Aug-2021	$	2,030
Dec-2021	$	3,335
Feb-2021	$	1,335
Jan-2021	$	1,363
Jul-2021	$	1,870
Jun-2021	$	2,175
Mar-2021	$	1,155
May-2021	$	2,183
Oct-2021	$	1,908
Sep-2021	$	1,908
[redacted]		
Apr-2021	$	3,425
Aug-2021	$	4,220
Dec-2021	$	3,300
Feb-2021	$	2,175
Jan-2021	$	2,585
Jul-2021	$	3,735
Jun-2021	$	4,310
Mar-2021	$	1,540
May-2021	$	4,320
Nov-2021	$	3,355
Oct-2021	$	3,690
Sep-2021	$	3,815
[redacted]		
Apr-2021	$	3,555
Aug-2021	$	4,055
Dec-2021	$	3,445
Feb-2021	$	2,090
Jan-2021	$	2,305
Jul-2021	$	3,545
Jun-2021	$	4,435
Mar-2021	$	2,260
May-2021	$	4,650
Nov-2021	$	3,550
Oct-2021	$	3,955
Sep-2021	$	3,850
[redacted]		
Apr-2021	$	3,425
Aug-2021	$	4,045
Dec-2021	$	3,085
Feb-2021	$	2,515
Jan-2021	$	2,485
Jul-2021	$	3,585
Jun-2021	$	4,365

Counterparty and Payment Dates		REC Cost
Mar-2021	$	2,295
May-2021	$	4,505
Nov-2021	$	3,365
Oct-2021	$	3,795
Sep-2021	$	3,665
[redacted]		
Apr-2021	$	3,108
Aug-2021	$	3,836
Dec-2021	$	2,932
Feb-2021	$	2,184
Jan-2021	$	2,256
Jul-2021	$	3,384
Jun-2021	$	3,880
Mar-2021	$	2,100
May-2021	$	4,052
Nov-2021	$	3,072
Oct-2021	$	3,540
Sep-2021	$	3,652
[redacted]		
Apr-2021	$	1,448
Dec-2021	$	1,655
Jan-2021	$	517
Jul-2021	$	2,689
Jun-2021	$	1,241
Mar-2021	$	517
Oct-2021	$	1,138
Sep-2021	$	2,689
[redacted]		
Apr-2021	$	3,470
Aug-2021	$	3,935
Dec-2021	$	3,275
Feb-2021	$	2,430
Jan-2021	$	2,525
Jul-2021	$	3,705
Jun-2021	$	4,215
Mar-2021	$	2,320
May-2021	$	4,400
Nov-2021	$	3,235
Oct-2021	$	3,540
Sep-2021	$	3,670
[redacted]		
Apr-2021	$	2,824
Aug-2021	$	3,760
Dec-2021	$	2,936
Feb-2021	$	2,152
Jan-2021	$	2,228
Jul-2021	$	3,488
Jun-2021	$	3,960
Mar-2021	$	1,928
May-2021	$	3,864
Nov-2021	$	2,984
Oct-2021	$	3,436
Sep-2021	$	3,544
[redacted]		
Apr-2021	$	348
Aug-2021	$	449
Dec-2021	$	343
Feb-2021	$	229
Jan-2021	$	253
Jul-2021	$	400

Dates and Amounts of Payments for RECs - Calendar Year 2021

Counterparty and Payment Dates		REC Cost
Jun-2021	$	476
Mar-2021	$	227
May-2021	$	505
Nov-2021	$	337
Oct-2021	$	426
Sep-2021	$	455
[redacted]		
Apr-2021	$	3,940
Aug-2021	$	4,680
Dec-2021	$	3,590
Feb-2021	$	2,605
Jan-2021	$	2,755
Jul-2021	$	4,530
Jun-2021	$	4,535
Mar-2021	$	2,510
May-2021	$	4,990
Nov-2021	$	3,415
Oct-2021	$	4,010
Sep-2021	$	4,535
[redacted]		
Apr-2021	$	3,040
Aug-2021	$	3,740
Dec-2021	$	2,832
Feb-2021	$	1,992
Jan-2021	$	2,132
Jul-2021	$	3,672
Jun-2021	$	3,636
Mar-2021	$	1,928
May-2021	$	3,840
Nov-2021	$	2,712
Oct-2021	$	3,132
Sep-2021	$	3,620
[redacted]		
Apr-2021	$	1,663
Aug-2021	$	1,926
Dec-2021	$	1,501
Feb-2021	$	1,096
Jan-2021	$	1,186
Jul-2021	$	1,856
Jun-2021	$	1,852
Mar-2021	$	1,008
May-2021	$	2,018
Nov-2021	$	1,406
Oct-2021	$	1,676
Sep-2021	$	1,827
[redacted]		
Apr-2021	$	2,262
Aug-2021	$	2,877
Dec-2021	$	2,265
Feb-2021	$	1,767
Jan-2021	$	1,845
Jul-2021	$	2,664
Jun-2021	$	2,991
Mar-2021	$	1,563
May-2021	$	3,099
Nov-2021	$	2,274
Oct-2021	$	2,655
Sep-2021	$	2,661
[redacted]		
Apr-2021	$	2,912

DUKE ENERGY PROGRESS, LLC
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Dates and Amounts of Payments for RECs - Calendar Year 2021

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Presson Exhibit 1, Appendix 2
June 14, 2022

Counterparty and Payment Dates		REC Cost
Aug-2021	$	3,772
Dec-2021	$	2,792
Feb-2021	$	2,188
Jan-2021	$	2,236
Jul-2021	$	3,448
Jun-2021	$	3,692
Mar-2021	$	2,024
May-2021	$	4,048
Nov-2021	$	2,876
Oct-2021	$	3,376
Sep-2021	$	3,352

[END CONFIDENTIAL]

REDACTED VERSION

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022: Total Units (Note 3)	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023: Total Units (Note 3)	Cost per Unit	Total Cost	RECs
1	[redacted]									
2										
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REDACTED VERSION

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022: Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023: Total Units Note 3	Cost per Unit	Total Cost	RECs
30	[redacted]									
31										
32										
33										
34										
35										
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REDACTED VERSION

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023 Total Units Note 3	Cost per Unit	Total Cost	RECs
59	[redacted]									
60	[redacted]									
61	[redacted]									
62	[redacted]									
63	[redacted]									
64	[redacted]									
65	[redacted]									
66	[redacted]									
67	[redacted]									
68	[redacted]									
69	[redacted]									
70	[redacted]									
71	[redacted]									
72	[redacted]									
73	[redacted]									
74	[redacted]									
75	[redacted]									
76	[redacted]									
77	[redacted]									
78	[redacted]									
79	[redacted]									
80	[redacted]									
83	[redacted]									
84	[redacted]									
85	[redacted]									
86	[redacted]									
87	[redacted]									
88	[redacted]									
89	[redacted]									

Compliance Costs

			EMF Period April 1, 2021 - March 31, 2022				Billing Period December 1, 2022 - November 30, 2023			
Line No.	Renewable Resource	RECs only	Total Units Note 3	Cost per Unit	Total Cost	RECs	Total Units Note 3	Cost per Unit	Total Cost	RECs
90	[redacted]									
91										
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94										
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Compliance Costs

			EMF Period April 1, 2021 - March 31, 2022				Billing Period December 1, 2022 - November 30, 2023			
Line No.	Renewable Resource	RECs only	Total Units Note 3	Cost per Unit	Total Cost	RECs	Total Units Note 3	Cost per Unit	Total Cost	RECs
119	[redacted]									
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123										
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REDACTED VERSION

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023 Total Units Note 3	Cost per Unit	Total Cost	RECs
148	[redacted]									
149										
150										
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152										
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REDACTED VERSION

Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023 Total Units Note 3	Cost per Unit	Total Cost	RECs
177	[redacted]									
178										
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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023 Total Units Note 3	Cost per Unit	Total Cost	RECs
206	[redacted]									
207										
208										
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Compliance Costs

Line No.	Renewable Resource	RECs only	EMF Period April 1, 2021 - March 31, 2022 Total Units Note 3	Cost per Unit	Total Cost	RECs	Billing Period December 1, 2022 - November 30, 2023 Total Units Note 3	Cost per Unit	Total Cost	RECs
232	[redacted]									
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234										
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Compliance Costs

			EMF Period April 1, 2021 - March 31, 2022				Billing Period December 1, 2022 - November 30, 2023			
Line No.	**Renewable Resource**	**RECs only**	**Total Units** Note 3	**Cost per Unit**	**Total Cost**	**RECs**	**Total Units** Note 3	**Cost per Unit**	**Total Cost**	**RECs**
255	[redacted]									
256										
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263										
264										
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266										
267	Other Incremental Cost (see Presson Exhibit No. 3 for Incremental Cost worksheet}				$ 1,633,962				$ 1,663,435	
268	Billing Period estimated credits for receipts related to contracts (see Presson Exhibit No. 3)				$ -	**Note 1**			$ (81,000) **Note 1**	
269	Solar Rebate Program (see Presson Exhibit No. 3 for cost detail)				$ 2,010,155				$ 2,497,768	
270	Research (see Presson Exhibit No. 3 for Research cost detail)				$ 767,383				$ 915,000	
271	**Total Research and Other Incremental Cost**				**$ 4,411,500**				**$ 4,995,203**	
272	**Total REPS Cost - to Williams Exhibit No. 1**				**$195,515,698**				**$ 178,286,747**	
273	EMF Period actual credits for receipts related to contracts - to Williams Exhibit No.4 - footnote (2)				$ (157,370)	**Note 1**				
					Presson Exhibit No.3					

Compliance Costs

			EMF Period April 1, 2021 - March 31, 2022				Billing Period December 1, 2022 - November 30, 2023			
Line No.	Renewable Resource	RECs only	Total Units Note 3	Cost per Unit	Total Cost	RECs	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 most recent base rate case. 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. Annual levelized costs are no longer calculated and reported in this exhibit.

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

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Line No.	Incremental Cost Worksheet:	EMF Period April 1, 2021 - March 31, 2022	Billing Period December 1, 2022 - November 30, 2023
	Labor by activity:		
1–21	[redacted]		
22	**Total Other Incremental Cost**	$ 1,633,962	$ 1,663,435
	Solar Rebate Program Cost Detail (recovery in REPS pursuant to G.S. 62-155(f)): (1)		
23	Annual Amortization of Incentives Provided to Customers, plus return on unamortized balance	$ 1,876,258	$ 2,331,598
24	Annual Amortization of Program Administrative Labor Costs, plus return on unamortized balance	[redacted]	
25	Annual Amortization of Program Administrative Contract Labor & Other Administrative Costs, plus return on unamortized balance		
26	**Total Solar Rebate Program Cost**	$ 2,010,155	$ 2,497,768

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

**Information in italics is confidential*

REDACTED VERSION

Line No.	Incremental Cost Worksheet:	EMF Period April 1, 2021 - March 31, 2022	Billing Period December 1, 2022 - November 30, 2023
	Research Cost Detail:		
27	Astrape Battery Storage Effective Load Carrying Capability Study (Note 2)	[redacted]	
28	Astrape Effective Load Carrying Capability Study		
29	Bring Your Own Battery Study		
30	CAPER - Developing large DER Protection Guidelines and Settings for Mitigating System-wide Impacts across T&D Systems		
31	Coalition for Renewable Natural Gas Membership		
32	DC Meter Testing Project		
33	Distributed Generation Cost-of-Service Study		
34	EPRI - Membership		
35	EPRI - Supplemental Projects		
36	NC State University's Future Renewable Electric Energy Delivery and Management ("FREEDM") Systems Center		
37	NCSU - Adopting DVAR to Mitigate PV Impact on a Distribution System Phase 2		
38	NCSU – Feeder Anti-islanding Detection Using HIL Modeling and Simulation		
39	NCSU - Swine Lagoon Sludge Research Study		
40	Research Triangle Institute - Biogas Utilitzation in NC		
41	Smart Electric Power Alliance		
42	Southeastern Wind Coalition		
43	UNCC - Power Flow Analysis to Improve Integrated Volt/Var Control (IVVC) and Energy Efficiency Programs		
44	UNCC - Reliability Assessment for Utility PV Inverter System		
45	UNCC - Resilient Community Microgrids with Dynamic Reconfiguration to Serve Critical Loads in the Aftermath of Severe Events		
46	**Total Research Cost**	**$ 767,383**	**$ 915,000**
47	**Total Other Incremental Cost**	$ 1,633,962	$ 1,663,435
48	Projected credits for receipts related to contract amendments/liquidated damages, etc	$ -	$ (81,000)
49	**Total Other Incremental Cost and other credits**	$ 1,633,962	$ 1,582,435
50	**Total Solar Rebate Program Cost**	$ 2,010,155	$ 2,497,768
51	**Total Research Cost**	$ 767,383	$ 915,000
52	**Grand Total - Other Incremental, Solar Rebate Program, and Research Cost, other credits**	**$ 4,411,500**	**$ 4,995,203**
53	EMF Period actual credits for receipts related to contracts - see **Note 1**	$ (157,370)	
54	**Net Other Incremental, Solar Rebate Program and Research Cost**	**$ 4,254,130**	**$ 4,995,203**

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: Project completed in 2020. Charges relate to final invoices received in 2021.

Information in italics is confidential

ASTRAPÉ CONSULTING
innovation in electric system planning

Duke Energy Carolinas and Duke Energy Progress Effective Load Carrying Capability (ELCC) Study

4/25/2022

PREPARED FOR

Duke Energy

PREPARED BY

Nick Wintermantel
Cole Benson
Astrapé Consulting

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I. Summary of Methodology and Results

This study was requested by Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) to analyze the capacity value of solar, storage, and wind within each system. Capacity value is the reliability contribution of a generating resource and is the fraction of the rated capacity considered to be firm. Average seasonal capacity values are used for reserve margin calculation purposes and seasonal marginal values can be used for expansion planning. Both Companies are winter planning due to winter peak loads and the amount of solar on the systems. As more solar is added, Loss of Load Expectation (LOLE) is shifted to the winter when solar provides less reliability contribution. Because of this winter planning, the winter capacity values were the focus of the study which can then be used for reserve margin accounting and expansion planning purposes.[1]

Because solar and wind are intermittent resources, a solar or wind facility's ability to provide reliable capacity when it is needed is different from that of a fully dispatchable resource such as a gas-fired turbine, which can be called upon in any hour to produce energy, notwithstanding unit outages. Similarly, battery systems have limited energy storage capability and must be recharged, either from the grid or a dedicated generation resource. A battery's ability to reliably provide capacity when it is needed will also differ from that of a fully dispatchable resource. The study results provide the winter capacity value for solar, storage, and wind which are used in the Companies' Carbon Plan and Integrated Resource Plans.

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[1] The Appendix includes one set of summer ELCC values for solar and wind for purposes of calculating DEC and DEP summer reserve margins. For determining marginal resources, the summer capacity values have no impact on plans because capacity needs are driven by the winter and resource adequacy risk is in the winter season given the level of solar being included in the plans.

A. Methodology

Astrapé performed this Effective Load Carrying Capacity (ELCC) study using the Strategic Energy Risk Valuation Model (SERVM) which is the same model used for DEC and DEP's past Resource Adequacy and ELCC Studies. The terms capacity value and ELCC are often used interchangeably for the purposes of this report. Additional details of the model setup and assumptions are included in the Technical Modeling Appendix of this report.

The Effective Load Carrying Capacity (ELCC) methodology was used to calculate the capacity value of the resource being studied. A "base" case of the system with no solar or storage was developed that resulted in the DEC and DEP systems achieving the 1 day in 10-year industry standard of 0.1 Loss of Load Expectation (LOLE). This is a common industry standard and ensures that these resources are being evaluated within a reliable system. Once the "base" case is established, battery, solar, and/or wind resources are added to the system. The additional resources improve LOLE to less than 0.1. Next, load is increased by adding a negative resource until the LOLE is returned to the same seasonal reliability as seen in the Base Case.[2] The ratio of the additional load to the additional resource being added is the reliability contribution or ELCC of the battery or renewable resource. For example, if 100 MW of battery is added and achieves the same Base Case seasonal LOLE after adding 90 MW of load, the ELCC is 90% (90 MW divided by 100 MW).

[2] Because it is difficult to return cases back to the exact seasonal reliability, several load levels were analyzed for each setup and interpolation was performed to determine the amount of load added to return to the Base Case seasonal LOLE.

As part of the 2020 IRP filed by the Companies, the Public Service Commission of South Carolina required the Companies to make several adjustments to its solar and storage ELCC studies.[3] For the Companies' Carbon Plan the following items have been taken into account in this study.

1. Perform Surface ELCCs for Solar and Storage –

   To accommodate the surface ELCC, Astrapé performed solar only ELCC analyses, storage only ELCC analyses, and storage and solar aggregated ELCC analysis to ensure any synergistic benefits were included. As laid out in the report, this analysis was performed over a broad range of capacity and storage durations. Previously, in the 2020 Storage ELCC Study, the storage ELCC analysis was performed with significant solar on the system, so all synergistic value was given to storage. Similar surface analysis was performed for wind and solar.

2. Use of 2035 Load Forecasts in the Analysis-

   Utilizing the 2035 load forecast captures a larger system and provides these resources more capacity value as the penetration increases.[4]

3. Use higher capacity factor solar resources –

   All future solar additions were modeled as bifacial, single-axis tracking resources.

4. Incorporate the Company's Winter Peak Demand Reduction Potential Assessment-

   The Winter Peak Study, which included additional demand response programs, adds demand response capacity in both winter and summer.[5]

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[3] South Carolina Docket Nos. 2019-224-E and 2019-225-E, Order No. 2021-447, June 28, 2021, at 87.
[4] Given this assumption, ELCCs could potentially be overstated prior to 2035.
[5] The 2020 Winter Peak Demand Reduction Potential Assessment (also referred to as the Winter Peak Study) was prepared for Duke Energy by Dunsky Energy Consulting in partnership with Tierra Resource Consultants. The objective of the study was to identify the potential for new demand response programs and measures to reduce the

B. Solar and Storage Scope

Astrapé calculated the average ELCC of solar and battery energy storage systems as shown in Tables 1 and 2 for both Companies. These tables show the surface that was analyzed across solar and storage resources for each Company. The highlighted blue cells were simulated representing only solar, only storage, and aggregated solar and storage scenarios. Each of the matrices were duplicated for 2-hour, 4-hour, 6-hour, 8-hour, and 12-hour storage systems. The surface methodology allows modelers to understand the benefit of each resource alone and together to determine any synergistic values the resources may have with one another. There is synergistic benefit between solar and storage resources because the resources work together to increase their value from a resource adequacy perspective. After adding a fixed solar profile, the net peak load (gross load minus solar) is typically narrower allowing for short duration storage to better serve the new net load peak.

winter peak demand in each of the DEC and DEP systems. The Winter Peak Study reports were filed with the NCUC in Docket No. E-100, Sub 165.

Table 1. DEC Solar Storage Surface Matrix[6]

		Solar MW						
	DEC	-	2,000	3,000	4,000	6,000	8,000	8,000
Battery MW	-							
	300							
	600							
	1,200							
	2,400							
	3,200							

Table 2. DEP Solar Storage Surface Matrix

		Solar MW						
	DEP	-	3,000	4,500	6,000	7,500	9,000	12,000
Battery MW	-							
	450							
	900							
	1,800							
	3,600							
	4,800							

C. Battery and Solar Modeling

For this study, battery resources were modeled in economic arbitrage mode. The objective of economic arbitrage mode is to maximize the economic value of the battery. In this mode, SERVM schedules the battery to charge at times when system energy costs are low, and to discharge when system energy costs are high. This type of dispatch aligns well with resource adequacy risks, meaning the battery will be available to discharge during peak net load conditions when loss of load events are most likely to occur. In this mode, SERVM offers recourse options during a

[6] The black highlighted areas were not simulated. If it became necessary, these values could be interpolated based on the simulated values.

reliability event. In other words, SERVM allows the schedule of the battery to be adjusted in real time, and discharge if its state of charge is greater than zero to avoid firm load shed. This method also assumes the utility has full control of the battery and best represents how batteries are expected to be operated on the DEC and DEP systems. Batteries were assumed to have no limits on ramping capability or constraints on number of cycles per day outside of the ability to charge the battery. Batteries were given an equivalent forced outage rate ("EFOR") of 2.4% compared to the negative resource (modeled as load) that was given a 4% outage rate.[7] By modeling resources with their unit specific EFOR values, all resources are captured on a level playing field. Solar was modeled with hourly profiles as described in the Technical Appendix, and a 2.7% outage rate. All new solar was based on bifacial single-axis tracking profiles.

D. Storage/Solar Surface Winter Results

Tables 3 and 4 show the average winter ELCC for battery without any solar included in the setup, solar without any battery included in the setup, and the synergistic ELCC's when both are included. For DEC, battery levels were modeled from 0 to 3,200 MW and solar resources from 0 to 8,000 MW. The synergistic values are higher than the single resource values especially as penetrations increase.

[7] The 4% outage rate represents the high end of new thermal resources such as new combined cycle or combustion turbine resources.

Table 3. DEC Winter Solar and Storage Results[8]

Solar MW	Battery MW	Duration Hours	Average Battery Capacity Value (no solar included)	Average Solar Capacity Value (no battery included)	Average Battery Capacity Value including any synergistic value	Average Solar Capacity Value including any synergistic value
2,000	200	2	99.2%	6.1%	100.0%	6.5%
3,000	400	2	97.8%	5.0%	100.0%	5.0%
4,000	600	2	96.4%	4.1%	98.7%	4.1%
5,000	800	2	95.1%	3.4%	95.7%	3.8%
2,000	300	4	99.5%	6.1%	99.9%	6.1%
3,000	600	4	99.8%	5.0%	99.8%	5.1%
4,000	1,200	4	98.5%	4.1%	98.8%	4.3%
5,000	2,400	4	87.3%	3.4%	94.0%	3.7%
6,000	3,200	4	73.5%	2.9%	88.4%	3.3%
8,000	3,200	4	73.5%	2.4%	88.6%	3.0%
2,000	300	6	99.8%	6.1%	100.0%	6.1%
3,000	600	6	99.4%	5.0%	100.0%	5.0%
4,000	1,200	6	97.4%	4.1%	99.3%	4.3%
5,000	2,400	6	88.7%	3.4%	95.6%	3.7%
6,000	3,200	6	79.2%	2.9%	91.7%	3.3%
8,000	3,200	6	79.2%	2.4%	91.8%	2.8%
2,000	300	8	99.6%	6.1%	99.6%	6.1%
3,000	600	8	99.6%	5.0%	99.6%	5.1%
4,000	1,200	8	98.1%	4.1%	98.3%	4.3%
5,000	2,400	8	89.6%	3.4%	94.7%	3.6%
6,000	3,200	8	79.8%	2.9%	91.0%	3.2%
8,000	3,200	8	79.8%	2.4%	92.6%	2.8%
2,000	300	12	99.8%	6.1%	100.0%	6.1%
3,000	600	12	99.5%	5.0%	99.8%	5.1%
4,000	1,200	12	97.7%	4.1%	98.3%	4.2%
5,000	2,400	12	90.2%	3.4%	94.8%	3.6%
6,000	3,200	12	82.1%	2.9%	92.1%	3.1%
8,000	3,200	12	82.1%	2.4%	92.7%	2.8%

[8] All values have been curve fitted to reflect smooth curves across the solar and storage penetrations resulting in minor adjustments for reporting purposes.

The same results are shown for DEP. The solar was simulated up to 12,000 MW and battery was simulated up to 4,800 MW.

Table 4. DEP Winter Solar and Storage Results[9]

Solar MW	Battery MW	Duration Hours	Average Battery Capacity Value (no solar included)	Average Stand-Alone Solar Capacity Value (no battery included)	Average Battery Capacity Value including any synergistic value	Average Solar Capacity Value including any synergistic value
3,000	300	2	97.7%	7.7%	100.0%	8.2%
4,500	600	2	91.2%	6.3%	96.2%	6.4%
6,000	900	2	84.8%	5.2%	90.4%	5.3%
7,500	1,200	2	78.4%	4.4%	83.3%	4.8%
3,000	450	4	100.0%	7.7%	100.0%	7.8%
4,500	900	4	95.8%	6.3%	96.6%	6.5%
6,000	1,800	4	86.9%	5.2%	88.4%	5.5%
7,500	3,600	4	68.3%	4.4%	73.4%	4.7%
9,000	4,800	4	55.3%	3.8%	64.5%	4.2%
12,000	4,800	4	55.3%	3.3%	64.5%	3.9%
3,000	450	6	100.0%	7.7%	100.0%	7.7%
4,500	900	6	97.5%	6.3%	98.3%	6.5%
6,000	1,800	6	93.5%	5.2%	94.5%	5.5%
7,500	3,600	6	78.2%	4.4%	84.1%	4.8%
9,000	4,800	6	62.5%	3.8%	75.1%	4.3%
12,000	4,800	6	62.5%	3.3%	75.1%	4.0%
3,000	450	8	100.0%	7.7%	100.0%	7.7%
4,500	900	8	97.8%	6.3%	98.8%	6.4%
6,000	1,800	8	95.0%	5.2%	96.4%	5.5%
7,500	3,600	8	81.6%	4.4%	87.3%	4.7%
9,000	4,800	8	66.9%	3.8%	78.0%	4.2%
12,000	4,800	8	66.9%	3.3%	78.0%	3.9%
3,000	450	12	100.0%	7.7%	100.0%	7.8%

[9] At the low battery capacity levels (450-900 MW), additional Monte Carlo outage iterations are likely required to understand any clear differences between battery durations which are showing capacity values all near 100%. For reporting purposes, minor adjustments were made. For example, if the 450 MW 8 hour was interpolated at 99% it was adjusted to 100% since the 6-hour showed 100% for 450 MW. All values have been curve fitted to reflect smooth curves across the solar and storage penetrations resulting in minor adjustments for reporting purposes.

4,500	900	12	97.8%	6.3%	98.8%	6.4%
6,000	1,800	12	95.6%	5.2%	96.5%	5.4%
7,500	3,600	12	85.2%	4.4%	88.8%	4.6%
9,000	4,800	12	71.1%	3.8%	79.3%	4.1%
12,000	4,800	12	71.1%	3.3%	79.3%	4.0%

Tables 5 and 6 show the same ELCC results but calculated as the marginal ELCC. These include any synergistic value between the solar and storage. The marginal values were developed by curve fitting the average results to a polynomial and taking the first derivative. A single set of solar winter values were reported since all the values were similar across all the battery durations. The marginal ELCC represents the next MW at each point in the penetration. For example, the 2401st MW of 4-hour storage is worth 79.4%.

Table 5. DEC Winter Marginal Values

Solar	Battery	Duration	Marginal Battery including any synergistic values	Marginal Solar including any synergistic values
2,000	200	2	100.0%	
3,000	400	2	98.0%	
4,000	600	2	93.9%	
5,000	800	2	89.8%	
2,000	300	4	100.0%	3.1%
3,000	600	4	100.0%	2.4%
4,000	1,200	4	94.9%	1.8%
5,000	2,400	4	79.4%	1.2%
6,000	3,200	4	69.0%	1.1%
2,000	300	6	100.0%	
3,000	600	6	100.0%	
4,000	1,200	6	96.2%	
5,000	2,400	6	85.2%	
6,000	3,200	6	77.9%	
2,000	300	8	100.0%	
3,000	600	8	99.3%	
4,000	1,200	8	95.0%	
5,000	2,400	8	86.5%	
6,000	3,200	8	80.8%	

2,000	300	12	100.0%	[redacted]
3,000	600	12	98.7%	[redacted]
4,000	1,200	12	95.0%	[redacted]
5,000	2,400	12	87.6%	[redacted]
6,000	3,200	12	82.7%	[redacted]

Table 6 shows the same information for DEP. At some point, batteries will flatten the net load shape, removing the arbitrage opportunity, making the value of the next MW of short duration storage much less valuable.

Table 6. DEP Winter Marginal Values

Solar	Battery	Duration	Marginal Battery including any synergistic values	Marginal Solar including any synergistic values
3,000	300	2	100.0%	[redacted]
4,500	600	2	85.1%	[redacted]
6,000	900	2	70.2%	[redacted]
7,500	1,200	2	55.4%	[redacted]
3,000	450	4	93.7%	4.7%
4,500	900	4	86.8%	3.2%
6,000	1,800	4	73.1%	1.7%
7,500	3,600	4	45.8%	1.7%
9,000	4,800	4	27.5%	1.6%
3,000	450	6	100.0%	[redacted]
4,500	900	6	97.9%	[redacted]
6,000	1,800	6	84.9%	[redacted]
7,500	3,600	6	59.0%	[redacted]
9,000	4,800	6	41.6%	[redacted]
3,000	450	8	100.0%	[redacted]
4,500	900	8	100.0%	[redacted]
6,000	1,800	8	88.5%	[redacted]
7,500	3,600	8	62.2%	[redacted]
9,000	4,800	8	44.7%	[redacted]
3,000	450	12	100.0%	[redacted]
4,500	900	12	100.0%	[redacted]
6,000	1,800	12	90.4%	[redacted]
7,500	3,600	12	64.2%	[redacted]
9,000	4,800	12	46.7%	[redacted]

In addition to standalone solar and standalone storage resources, the Companies also include storage that is "DC coupled" with solar in their capacity expansion model. While not explicitly analyzed in this study, it is reasonable to assume that the ELCC of the solar resource and the ELCC of the storage resource are additive. As an example, a 100 MW solar facility that is DC-coupled with a 50 MW, 4-hour storage facility in DEP should have a firm capacity rating of approximately 52 MW (100 MW solar * 4.7% + 50 MW, 4-hour storage * 93.7%).

E. Sensitivity – 6-Hour Standalone Winter Battery Capacity Values Beyond 4-Hour Values

Additional surface analysis was performed to understand how 6-hour storage performed after significant 4-hour storage had already been added to the system. For these runs, storage and solar were added together as in the previous analysis to capture the synergistic value. The results are listed in Tables 7 and 8.

Table 7. DEC Winter 6-Hour after 4-Hour Battery

Solar	Battery	Duration	Average Battery Capacity Value (including any synergistic value)	Marginal Battery Capacity Value (including any synergistic value)
2,000	300	4	100%	100%
3,000	600	4	100%	100%
4,000	1,200	4	99%	95%
5,000	2,400	4	94%	79%
6,000	3,200	4	88%	69%
8,000	4,000	6	81%	51%
8,000	5,000	6	74%	38%

Table 8. DEP Winter 6-Hour after 4-Hour Battery

Solar	Battery	Duration	Average Battery Capacity Value (including any synergistic value)	Marginal Battery Capacity Value (including any synergistic value)
3,000	450	4	100%	94%
4,500	900	4	97%	87%
6,000	1,800	4	88%	73%
7,500	2,300	6	90%	85%
7,500	2,800	6	87%	68%

One last sensitivity was performed for DEC evaluating the existing Bad Creek Pump Hydro Facility. DEC's existing Bad Creek (BC1) is modeled with 19 hours of storage and 1,640 MW of capacity. Because of its long duration, existing pump storage on the system was assumed to provide nearly 100% capacity value. DEC is evaluating adding a second powerhouse (Bad Creek 2 or BC2) at the existing Bad Creek 1 facility. In that case, Bad Creek 1 is reduced to 12 hours and an incremental 1,680 MW of 12-hour duration storage capacity is added. To assess the impact of reduced duration of Bad Creek 1 on the incremental 12-hour storage created by the addition of Bad Creek 2, the 12-hour surface analysis was rerun assuming a lower duration BC1. This analysis, depicted in Table 9, determined that the capacity value of incremental 12-hour storage decreases slightly with a reduction in BC1 storage duration.

Table 9. DEC Winter 12-Hour Bad Creek 2 Sensitivity

Solar	Battery	Duration	Average Battery Capacity Value BC1 @ 19 hours including any synergistic value	Marginal Battery Capacity Value BC1 @ 19 storage including any synergistic value	Average Battery Capacity Value BC1@ 12 hours including any synergistic value	Marginal Battery Capacity Value BC1@ 12 hours including any synergistic value
2,000	300	12	100.0%	100.0%	100.5%	100.0%
3,000	600	12	99.8%	98.7%	99.6%	98.3%
4,000	1,200	12	98.3%	95.0%	97.7%	93.6%
5,000	2,400	12	94.8%	87.6%	93.5%	84.1%
6,000	3,200	12	92.1%	82.7%	90.2%	77.8%

F. Wind Resources

Wind resources were modeled as hourly profiles provided by the Companies. The Technical Appendix provides more information surrounding these shapes. Wind profiles were provided assuming a 2.6% outage rate compared to the negative resource that was assumed to have a 4% outage rate.

G. Wind/Solar Surface Scope

Astrapé calculated the average ELCC of wind and solar as laid out in Tables 10 and 11 for both Companies. The highlighted blue cells were simulated representing only wind, only solar, and aggregated solar and wind scenarios. Each of the matrices were duplicated for offshore and onshore wind for both Companies.

Table 10. DEC Solar/Wind Surface Matrix

		Solar MW			
	DEC	-	2,000	4,000	6,000
Wind MW	-				
	1,000				
	2,000				
	3,000				

Table 11. DEP Solar/Wind Surface Matrix

		Solar MW			
	DEP	-	3,000	6,000	9,000
Wind MW	-				
	1,000				
	2,000				
	3,000				

H. Winter Wind/Solar Surface Results

Tables 12 and 13 show the average winter ELCC for wind without any solar included in the setup, solar without any wind included in the setup, and the ELCC's when both are included to capture any synergistic value the resources have. There was very little synergistic value seen in the onshore wind and solar analysis but a higher amount in the offshore wind and solar analysis. DEC was modeled with solar from 0 to 6,000 MW and wind from 0 to 3,000 MW. DEP was modeled with solar from 0 to 9,000 MW and wind from 0 to 3,000 MW. The profiles provided by the Company showed substantial output during cold winter mornings in the offshore wind profiles.[10] Even for winter values, to see ELCC's of this magnitude for offshore wind, particularly in DEC, is not intuitive and it is recommended that the Companies continue to understand offshore wind profiles especially during extreme cold periods.

Table 12. DEC Winter Wind Results

Solar MW	Wind MW	Offshore/ Onshore	Average Wind Capacity Value (no solar included)	Average Solar Capacity Value (no wind included)	Average Wind Capacity Value (including any synergistic value)	Average Solar Capacity Value (including any synergistic value)	Marginal Wind Capacity Value (including any synergistic value)
2,000	1,000	Onshore	39.9%	6.1%	40.7%	6.6%	29.1%
4,000	2,000	Onshore	36.9%	4.1%	36.9%	3.9%	32.0%
6,000	3,000	Onshore	35.8%	2.9%	34.9%	3.0%	35.0%
2,000	1,000	Offshore	89.5%	6.1%	94.9%	6.9%	86.6%
4,000	2,000	Offshore	84.2%	4.2%	89.3%	4.3%	80.7%
6,000	3,000	Offshore	76.4%	2.9%	85.5%	3.4%	74.8%

[10] Profiles are based on "ERA5" climate and weather data from the European Centre for Medium-Range Weather Forecasts. More information can be found at: https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels?tab=overview

Table 13. DEP Winter Wind Results

Solar MW	Wind MW	Offshore/ Onshore	Average Wind Capacity Value (no solar included)	Average Solar Capacity Value (no wind included)	Average Wind Capacity Value (including any synergistic value)	Average Solar Capacity Value (including any synergistic value)	Marginal Wind Capacity Value (including any synergistic value)
3000	1000	Onshore	44.3%	7.7%	43.2%	7.8%	42.1%
6000	2000	Onshore	40.9%	5.2%	41.9%	5.4%	39.2%
9000	3000	Onshore	39.1%	3.8%	40.5%	4.1%	36.3%
3000	1000	Offshore	72.8%	7.7%	81.8%	6.9%	69.7%
6000	2000	Offshore	71.4%	5.2%	74.4%	5.5%	64.3%
9000	3000	Offshore	67.6%	3.8%	70.1%	4.1%	58.9%

I. Winter ELCC Conclusions

Winter ELCC's are a driver in resource plans for the Companies. Astrapé has taken an approach to recognize the synergistic value of combinations of resources. The winter storage ELCC's are at or near 100% for the first couple of battery tranches, but eventually these values will drop dramatically given winter load shapes can remain high across the day. Once enough storage is on the system, the net loads flatten to the point storage is needed in both the evening and morning peaks with limited reserve capacity available throughout the night to recharge the batteries. Solar values remain low during the winter as the risk of load shed is mostly during the early morning hours. The ELCC of onshore wind is in the 30-40% range while the ELCC of offshore wind was calculated to be north of 60%. This is driven by the ERA-5 shapes provided by the Company which show extremely high wind output during the coldest winter mornings. The average winter values should be used for reserve margin accounting and the marginal winter values should be used for marginal resource decision making since the needs of the Companies are in the winter.

II. Technical Modeling Appendix

The following sections include a discussion on the setup and assumptions used to perform the ELCC study. The Study utilized the framework from the 2020 Resource Adequacy study and updated the following inputs.

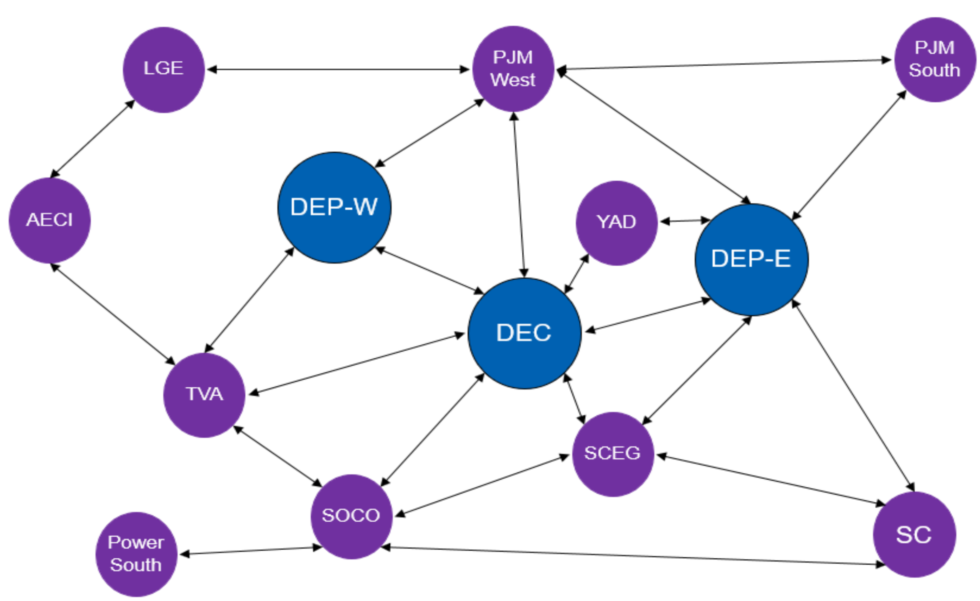
A. SERVM Framework and Cases

The study uses the same framework as the Base Case 2020 Resource Adequacy Study but was updated to model study year 2026 and included forty-one weather years (1980 – 2020), five load forecast error multipliers, and Monte Carlo generator outages.

B. Study Topology

The 2020 Resource Adequacy study was updated to include the additional SEEM entities Louisiana Gas and Electric (LGE), Associated Electric Cooperative Incorporated (AECI), and Power South. The study topology is shown below in Figure 1.

Figure 1. Study Topology



In order to reduce the simulation time for the ELCC analysis, the neighbors were tuned to 0.1 reliability in a calibration study. Purchases were derived from this calibration study to simulate the benefit received from the market. This allowed DEC and DEP to be simulated as islands for all the ELCC analyses.

C. Load Modeling

The load modeling was updated to model forty-one historical weather years (1980- 2020). The same methods used in the 2020 Resource Adequacy Study were used for this update. Based on the last five years of historical weather and load, a neural network program was used to develop relationships between weather observations and load. The historical weather consisted of hourly temperatures from weather stations across the DEC and DEP service territories. Other inputs into the neural net model consisted of hour of week, eight hour rolling average temperatures, twenty-four hour rolling average temperatures, and forty-eight hour rolling average temperatures. Different weather to load relationships were built for the summer, winter, and shoulder seasons. These relationships were then applied to the last forty-one years of weather to develop forty-one synthetic load shapes for 2026. Extreme peaks were corrected based on regression analysis examining extreme peak periods for both winter and summer. Equal probabilities were given to each of the forty-one load shapes in the simulation. The synthetic load shapes were scaled to align the normal summer and winter peaks to the Company's projected thirty-year weather normal load forecast for 2026.

D. Economic Load Forecast Error

Economic load forecast error multipliers from the 2020 Resource Adequacy were updated to reflect additional historical data. The updated values are shown in Table 14. Because the system is driven to 0.1 before the analysis begins, these assumptions don't drive the ELCC analysis significantly.

Table 14. Load Forecast Error

Load Forecast Error Multipliers	Probability %
0.96	10.4%
0.98	23.3%
1.00	32.5%
1.02	23.3%
1.04	10.4%

E. Conventional Resource Modeling

The resource mixes for DEC, DEP-E, and DEP-W were all updated to reflect any changes in the fleets since the 2020 Resource Adequacy Study was performed. Additionally, all modeled outage rates for the thermal fleet were updated to reflect the five most recent years of GADS data.

F. Renewable Resource Modeling

The solar units were modeled with updated forty-one solar shapes that represent forty-one years of weather data. The solar shapes were developed by Astrapé from data downloaded from the National Renewable Energy Laboratory (NREL) National Solar Radiation Database (NSRDB) Data Viewer. The data was then input into NREL's System Advisor Model (SAM) for each year and county to generate hourly profiles for both fixed and tracking solar profiles. Figure 2 below shows the county locations that were used and then Figure 3 shows the average August output for different fixed-tilt and single-axis-tracking inverter loading ratios.

Figure 2. Solar Location Map

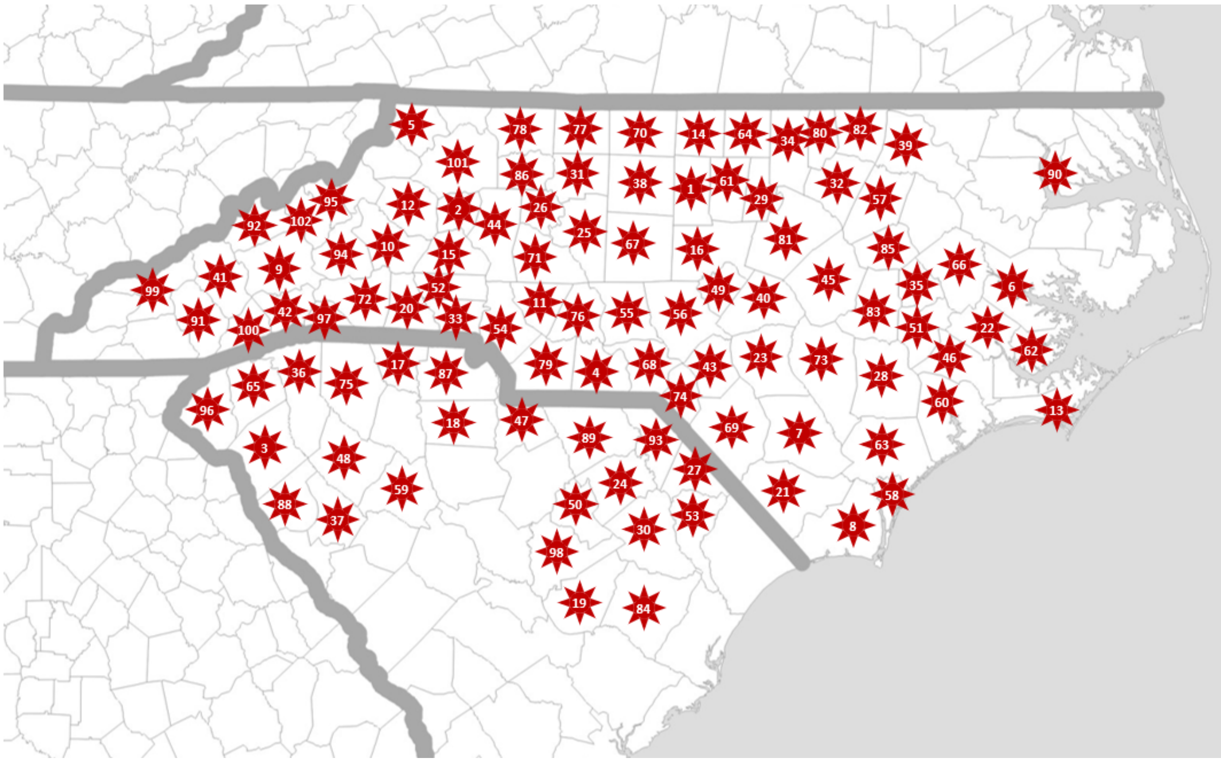
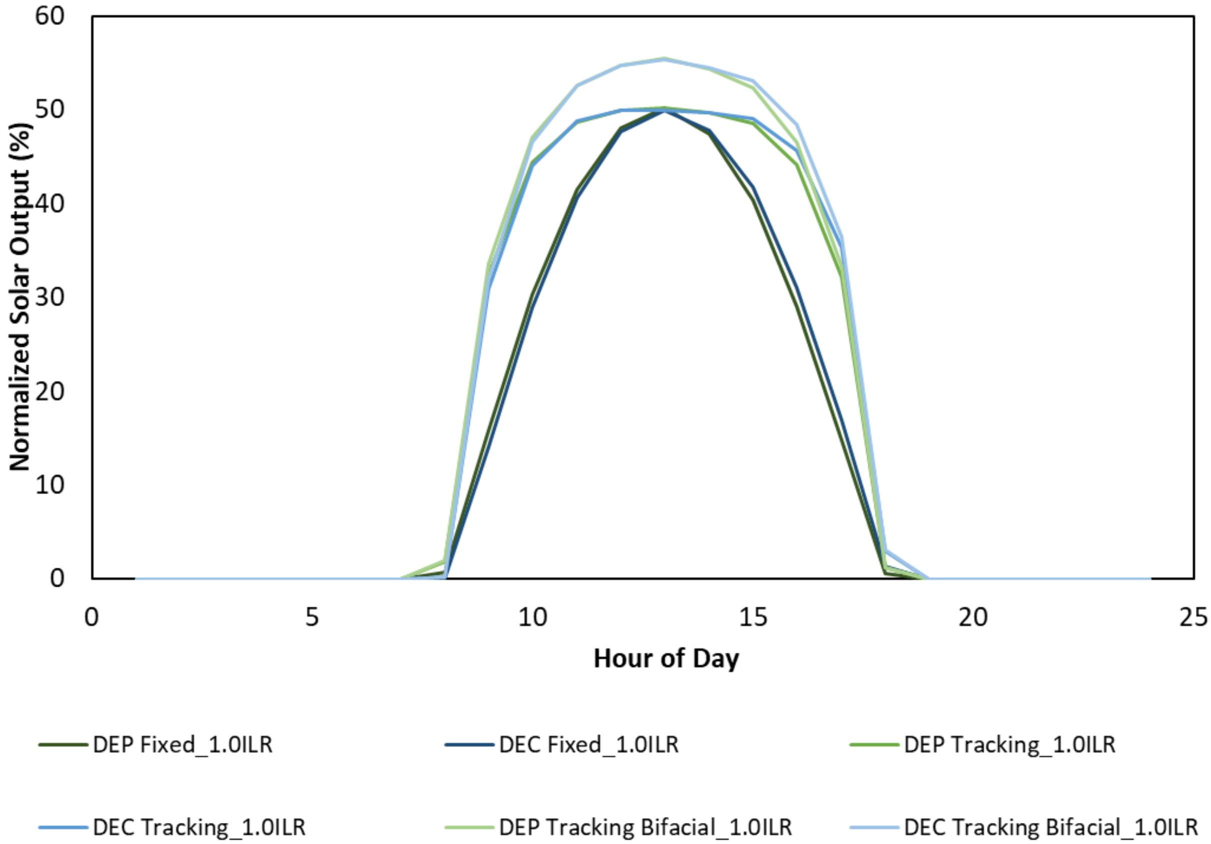


Figure 3. Average January Solar



The onshore and offshore wind profiles were provided by DEC and DEP and were derived from ERA-5 meteorological data. Figures 4 and 5 outline their average output and then a comparison of their output on peak days. Given the high output of offshore profiles on peak days, it is understandable that these profiles would result in a high ELCC value.

Figure 4. Average January Onshore and Offshore Wind Output

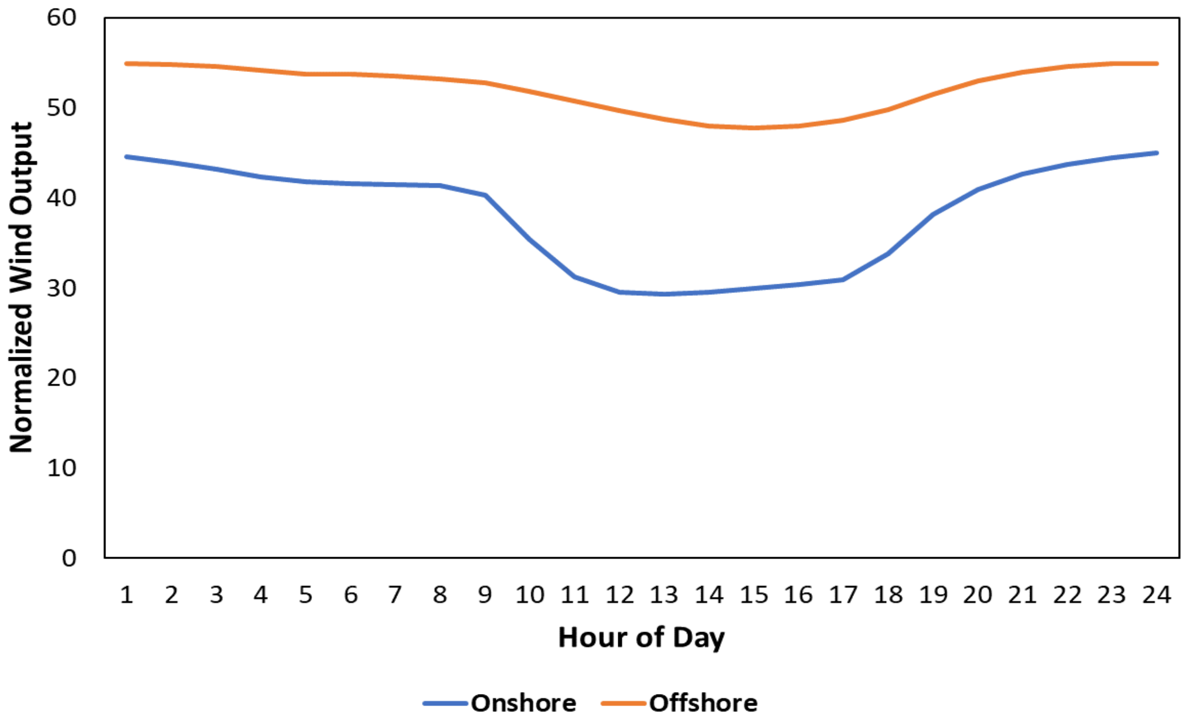
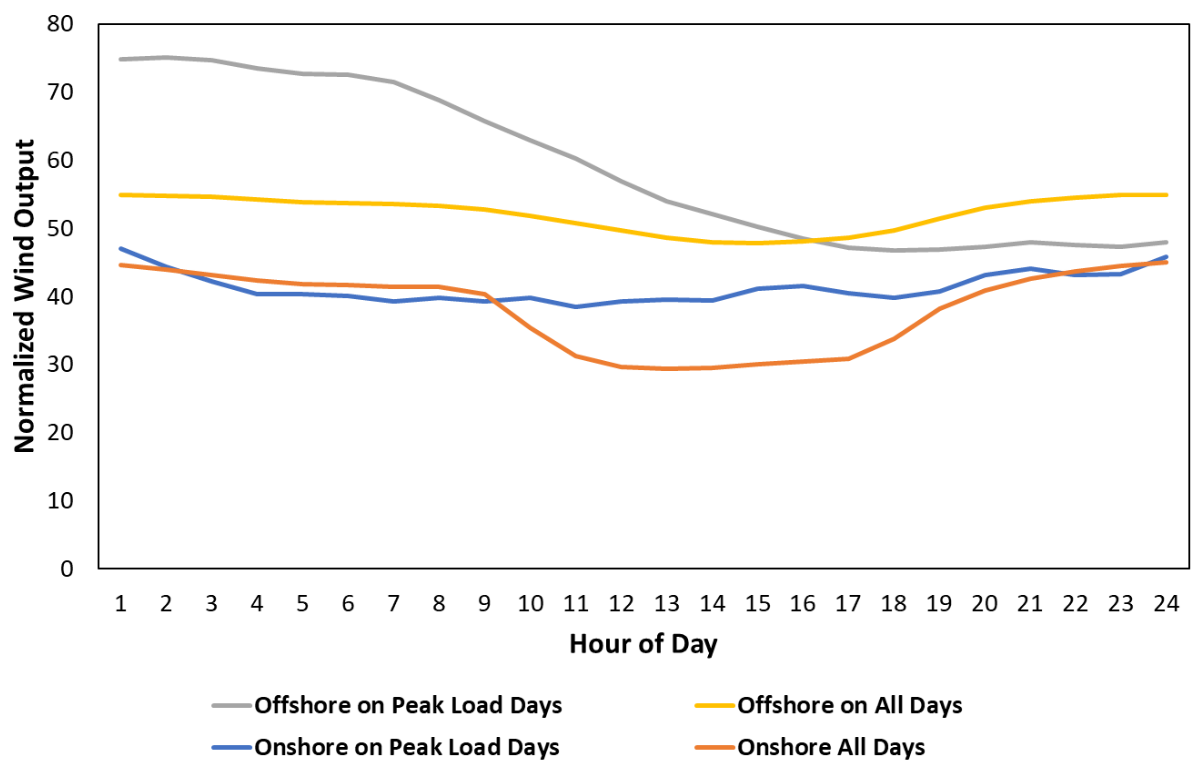


Figure 5. Peak Load Day January Onshore/Offshore Wind Output



G. Summer Solar and Wind ELCC Values

While summer was not the focus of this study, summer ELCC values were calculated for solar and wind for reserve margin accounting purposes. The Solar ELCC values are listed in Table 15 below. This analysis was only performed for DEC since there was summer LOLE in the Base Case before any solar was added. There was essentially zero LOLE in the summer in DEP even before solar is added so additional runs were not performed DEP because it would require manipulating the Base Case further to produce summer LOLE. These summer values give reasonable estimates for reserve margin accounting purposes and can be reasonably used for both Companies. But as discussed previously, because solar increases summer capacity more than winter capacity, summer reserve margins are increasing faster making future resource decisions driven by winter capacity need.

Table 15. Summer Solar ELCC Values

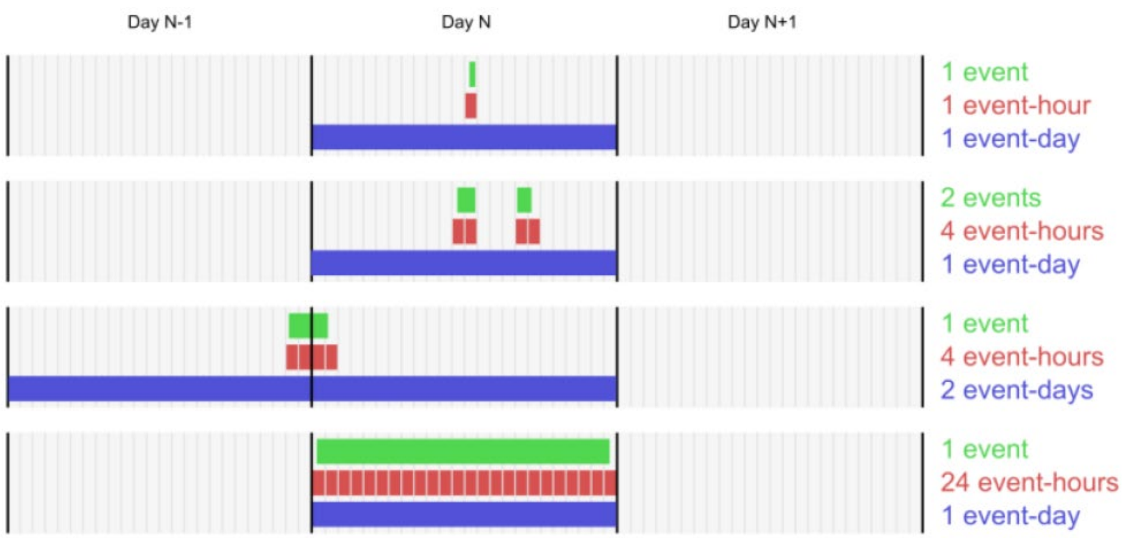
Solar MW	Storage (MW)	Summer Solar Average ELCC	Summer Solar Marginal ELCC
2000	300	67%	37.9%
3000	600	56%	34.3%
4000	1,200	51%	30.8%
5000	2,400	46%	24.0%
6000	3,200	42%	18.6%
8000	3,200	35%	7.9%

Onshore wind was found to provide approximately 11% in the summer and offshore wind was found to provide approximately 37% in the summer.

H. Discussion of Reliability Metrics (LOLE vs. EUE)

As part of the analysis, Astrapé did examine the impact the reliability metric used had on the ELCC values. Traditional resource adequacy only considers LOLE which counts the number of days customers are not served. LOLE is counted as one day whether the day has one hour or ten hours of load shed. Under this metric, two portfolios can have the same number of days of load shed but one portfolio could have substantially more load shed from an energy standpoint. This is illustrated in Figure 6 below where the first, second and fourth portfolios have the same number of days from a LOLE perspective but may differ in the number of hours and customer energy unserved.

Figure 6. LOLE Illustration[11]



Expected Unserved Energy (EUE) is another reliability metric which measures all customer energy demand not served. To better understand the impact a change in reliability metric may have on the results, Astrapé analyzed battery capacity values using EUE instead of LOLE as the ELCC

[11] Clarifying the Interpretation and Use of the LOLE Resource Adequacy Metric-2021 NERC Probabilistic Analysis Forum October 5th, 2021

metric. The winter results seen in Table 16 show that for short term storage, the capacity values based on EUE are substantially lower than of the LOLE results. This is logical because a 2-hour battery may still eliminate some events that a fully dispatchable resource can eliminate, but during events that remain it is likely that there will be more EUE with short duration battery. This is an interesting finding of the study that should be noted for future analysis. The opposite occurs for solar because solar cannot typically eliminate the entire event since most of the load shed in the winter events are before the sun rises, but it can eliminate EUE in hours 8 and 9. These results are shown in Table 17. For this reason, using EUE as the metric actually benefits solar. Planning reserve margin studies across the industry have used LOLE and the 1-day in 10-year standard so changing metrics for ELCC would create an accounting disconnect that would require further adjustments to the overall resource adequacy framework.

Table 16. DEC LOLE vs EUE Winter Battery ELCC Results

Battery (MW)	Duration(hours)	Average Battery Capacity Values with no solar included LOLE Base Results	Average Battery Capacity Values with no solar included EUE Results	Delta (EUE - LOLE)
400	2	97.8%	60.7%	-37.1%
600	2	96.4%	60.0%	-36.4%
800	2	95.1%	57.8%	-37.3%
600	4	99.8%	82.1%	-17.8%
1,200	4	98.5%	77.5%	-21.0%
2,400	4	87.3%	75.4%	-11.9%
3,200	4	73.5%	59.6%	-14.0%
600	6	99.4%	93.4%	-6.1%
1,200	6	97.4%	90.1%	-7.3%
2,400	6	88.7%	78.3%	-10.4%
3,200	6	79.2%	70.2%	-9.0%
600	8	99.6%	95.1%	-4.4%
1,200	8	98.1%	94.0%	-4.1%
2,400	8	89.6%	84.7%	-4.9%
3,200	8	79.8%	69.7%	-10.1%
600	12	99.8%	98.2%	-1.7%
1,200	12	99.5%	93.1%	-6.4%
2,400	12	97.7%	93.7%	-4.0%
3,200	12	90.2%	84.4%	-5.8%

Table 17. DEC LOLE vs EUE Winter Solar ELCC Results

Solar (MW)	Average Solar Capacity Value with no storage included LOLE Results	Average Solar Capacity Value with no storage included EUE Results
2,000	6.1%	8.2%
3,000	5.0%	6.2%
4,000	4.1%	5.7%
5,000	3.4%	5.1%
5,000	2.9%	4.9%
5,000	2.4%	3.8%

DUKE ENERGY

Bring Your Own Battery Study Update

SUMMARY:
As variable renewable energy sources like wind and solar increase in market penetration, there is a greater need for grid flexibility to meet fluctuations in generation. Storage is a helpful companion for renewables such as wind and solar in that energy can be stored during high generation periods of time for use in future low generation periods of time. Residential customers in North Carolina are adopting residential battery storage technology at a growing rate and there is potential benefit to all Duke Energy customers in this technology for a variety of use cases. A technology study utilizing Renewable Energy Portfolio Standard (REPS) research funding will allow Duke Energy to study aggregation technology, battery discharge, customer usage patterns, and the customer experiences that could inform a future pilot or program filing.

STUDY UPDATE:
The study began work in Q3 of 2021 with the onboarding of an aggregator platform that receives battery data and controls existing batteries. Customer invitations to participate in the study were sent out in Q1 of 2022. The study will gather 12 months of data from 65 residential customers starting in Q2 of 2022. Duke Energy will report findings no later than May 2023.

- Aggregation Technology:
  - Aggregator platforms serve as an interface between different distributed energy resources (DER) by managing the cloud-to-cloud communication for the various original equipment manufacturers (OEM) and utilities.
  - Some commercially viable aggregators can manage the control and data collection for different devices including battery storage.
  - Aggregator platforms allow for customers to choose the battery storage system of their preference and then enroll their devices into a program with a utility.
  - For the purposes of this study, Duke Energy secured the services of an aggregator vendor, Virtual Peaker, that can control and collect data from battery storage OEMs: Generac and SolarEdge

- Battery Discharge:
  - This study could prove the technology efficacy and demonstrate the expected additional capacity that these devices could provide.
  - Controlling residential batteries through an aggregator is an unproven technology among Duke Energy customers.
  - Residential customers who have an approved interconnection agreement and have paired their solar generation with a Generac or SolarEdge battery system are eligible for the study. This includes customers who are leasing or financing their systems through Sunrun and PowerHome Solar.
  - There are different installation configurations of a residential battery storage system that could limit the amount of energy discharged from the battery. For the purposes of this study, we will not discharge a customer's battery below a 50 percent state of charge at any time.
  - Duke Energy will not send a command (also referred to as an "event") to customers' battery systems to discharge if the 72-hour weather forecast calls for hurricanes, tropical storms, tropical depressions or even tropical disturbances near or approaching the area, allowing study participants to continue to use their battery storage systems as a backup energy solution.
  - Duke Energy will run up to 5 events per month over a 12-month period.
  - Customers will be given at least 2 hours' notice prior to events via their preferred communication method.

DUKE ENERGY.

Bring Your Own Battery Study Update

  - Customers may opt out of up to 5 events during the 12-month study.
  - If customers opt out of more than 5 events, unenroll, move or otherwise become ineligible to participate, they will not receive the second $100 check.
  - In event notifications, customers will be provided a link to opt out of an event.

- Customer Usage Patterns:
  - Utilizing the interval data available from these batteries, Duke Energy expects to model and forecast the expected additional capacity that these devices could provide.

- Customer Experience:
  - Designing a future pilot or program that centers on residential storage requires feedback from customers so that Duke Energy can design a program that meets the needs of all customers.
  - Study participants will receive $100 at the beginning of the study and $100 at the end of the 12-month period.

STUDY COSTS:

The costs for this program are $100,000 in DEC and $85,000 in DEP. These costs are allocated based on the total participants in each operating company. Funds are disbursed for 2021 and 2022 for aggregator vendor services.

PRESSON CONFIDENTIAL EXHIBIT NO. 6

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Economic Analysis of the US Renewable Natural Gas Industry

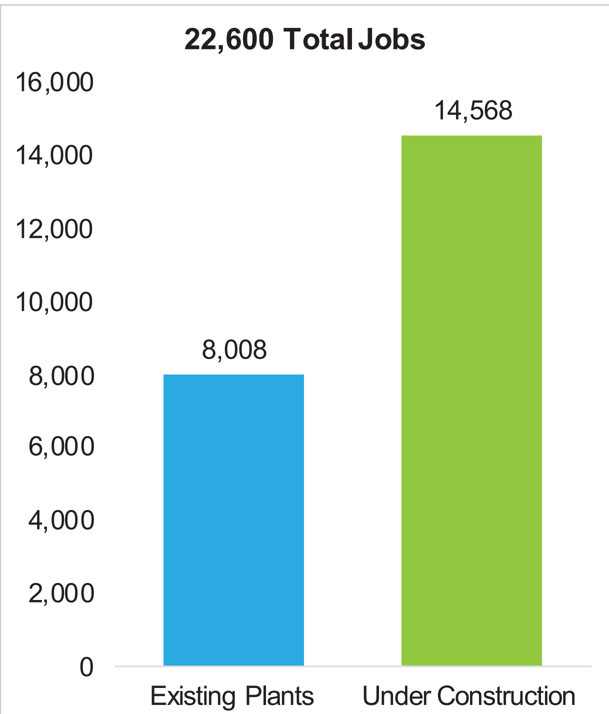
December 2021

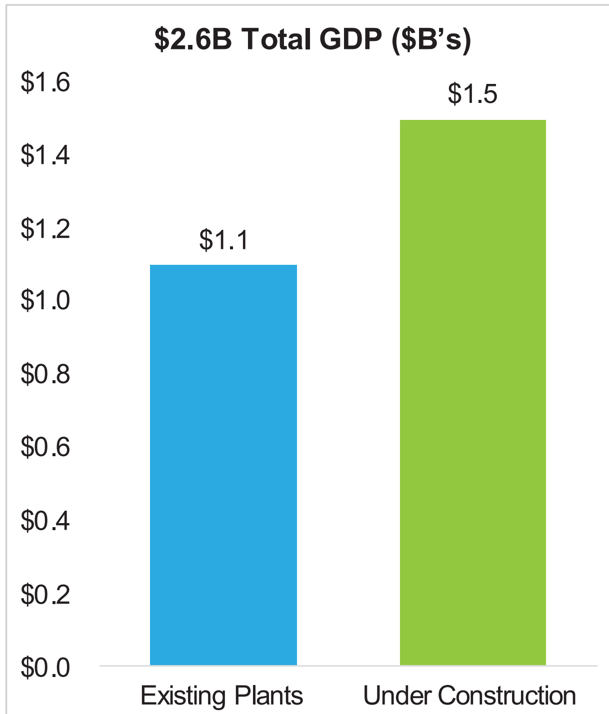
THE COALITION FOR RENEWABLE NATURAL GAS

Contents

Renewable Natural Gas (RNG) is Estimated to Contribute 22,600 Jobs, $2.6B in GDP, and $5.4B in Total Business Sales for Operations and Capital Expenditures in 2021

These numbers include the direct, indirect, and induced effects of existing RNG facilities and facilities currently under construction. Construction jobs require the approval of additional RNG facilities to continue to contribute to the economy.





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RNG Has Potential to Grow into a Formative Green Industry

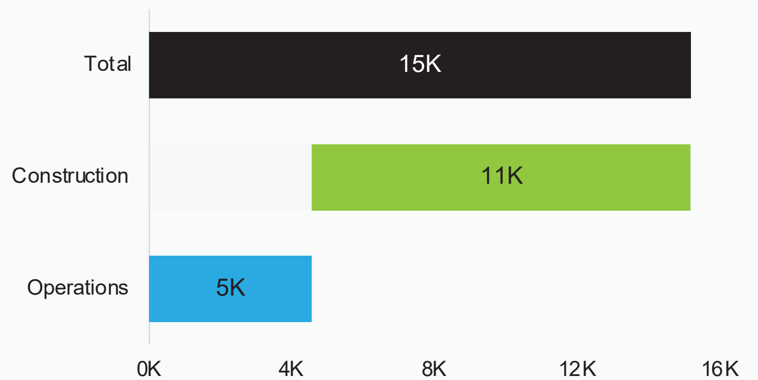
These numbers demonstrate the employment potential of RNG should it grow as expected based on RNG Coalition scenarios.

12 Jobs created for every $1 million spent on RNG in 2021

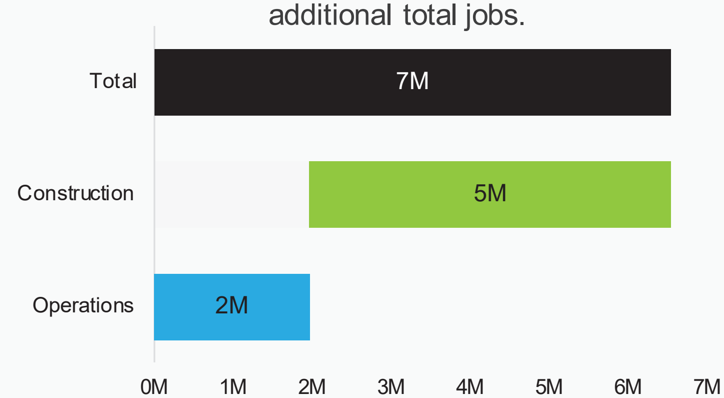
278 Jobs created per 1 million MMBTU of RNG in 2021

24 Jobs created per 1 million EGE[1] of RNG in 2021

Each additional **100 RNG facilities** creates an average 4,550 operations jobs and 10,634 construction jobs



If RNG Coalition's SMART[2] Initiative goal of **43,000 facilities** is met by 2050, this would create an estimated 6,528,938 additional total jobs.



1 Ethanol Gallon Equivalent

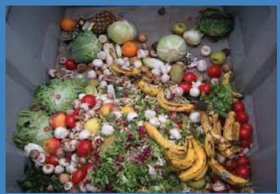
2 Sustainable Methane Abatement and Recycling Timeline

Employment Levels Vary Based on RNG Feedstock

A single Wastewater project creates an average of 141 total jobs, a single Livestock Waste project creates an average of 79 total jobs, a single Food Waste Project creates an average of 297 total jobs, and a single MSW project creates an average of 343 jobs.[3]

Adding an additional Wastewater project would create an average of 50 direct, 37 indirect, and 54 induced jobs – for 141 total jobs

Adding an additional Livestock Waste project would create an average of 25 direct, 22 indirect, and 32 induced jobs – for 79 total jobs



Adding an additional Food Waste project would create an average of 116 direct, 158 indirect, and 238 induced jobs – for 297 total jobs

Adding an additional MSW project would create an average of 115 direct, 94 indirect, and 134 induced jobs – for 343 total jobs

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[3] Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by the RNG Coalition.

This Study Sets Out to Analyze the Current Economic Contribution of RNG to the US Economy in 2021

This report is comprised of four sections:

1. **RNG Overview**
   Introduces renewable natural gas (RNG)

2. **RNG Value Chain**
   Overview of the RNG value chain from waste collection to final use

3. **Expenditure Analysis**
   Calculates the spending associated with RNG 1) existing plants and 2) plants under construction

4. **Economic Impact**
   Estimates jobs, GDP, and sales associated with RNG 1) existing plants and 2) plants under construction

This study answers the following questions:

1. What is RNG and how is it produced?
2. What are the stages within the RNG value chain?
3. What are the costs of RNG?
4. What impact does RNG have on the U.S. economy?

1 RNG Overview: RNG is a Clean, Affordable, and Reliable Waste-Derived Fuel that can be Used as Transportation Fuel for Vehicles, Generation of Electricity, and Thermal Heating Applications

RNG is a type of fuel that comes from a variety of waste sources. As that waste breaks down, biogas is captured through Anaerobic Digestion, Thermal Gasification, Pyrolysis, or Power-to-Gas technologies. The biogas is refined into biomethane (another name for RNG) after carbon dioxide, hydrogen sulfide, and other gases are removed. Crucially, biomethane is fully interchangeable with natural gas and can be used for local uses or injected into natural gas distribution systems. This report will cover the four feedstocks of Anaerobic Digestion, the most common RNG technology: Wastewater, Food Waste, Livestock Waste, and Municipal Solid Waste (MSW).

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1 RNG Overview: Because of its Greenhouse Gas (GHG) Reducing Potential, RNG is Considered a Low-Carbon Fuel Under the Federal Renewable Fuel Standard and State Low-Carbon Fuel Standards

All sectors of the U.S. economy will need to decarbonize dramatically to reach mid- to long-term GHG emissions targets set by a growing number of states, enabling new business opportunities for RNG. RNG from organic wastes leads to GHG reductions in two ways:

1. Displacing the use of diesel in vehicles

RNG can facilitate the displacement of life-cycle GHG emissions from fossil fuel use in vehicles[6]

RNG reduces **660** million gallons of diesel consumed by heavy duty vehicles[5]

Filling approximately **3 million** semi trucks or **7.3 million** transit buses

Reducing **14,792** million pounds of CO_2 emissions

2. Reducing emissions from waste

Waste accounts for one third of U.S. methane production and 3 percent of total U.S. GHG emissions.[4] Food waste is often sent to a landfill where methane is released or burned (e.g., turned into carbon dioxide) which enters the atmosphere. Other types of organic waste are placed in an open lagoon and release methane. To produce RNG, these gases are captured and cleaned rather than being released directly into the atmosphere

[4]RNG's life-cycle net impact on GHG emissions also depends on the feedstock used, how much GHG would have otherwise been produced from fossil fuels, and how much methane escapes during RNG capture & upgrade

[5]Total RNG volume as of 2021 converted from RNG in Ethanol Gallon Equivalents (EGE) to Diesel Gallon Equivalents (DGE) using conversions found at: https://nhcleancities.org/2017/04/can-compare-energy-content-alternative-fuels-gasoline-diesel/

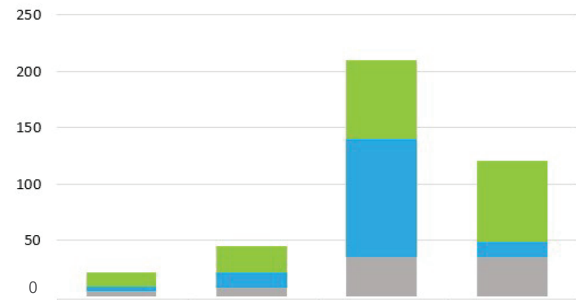
[6]World Resources Institute, 2015

1 RNG Overview: State of RNG Supply

RNG capacity in 2021 is nearly 74 trillion BTU's. RNG equates to nearly 870 million gallons of ethanol gallon equivalent (EGE) or 660 million gallons of diesel gallon equivalent (DGE). At the mid-point of 2021, there are 176 operational RNG facilities and 220 facilities that are under construction or planned. The agriculture sector has the most projects under construction for collecting and upgrading biogas into RNG.[7]

Status of RNG Facilities by Feedstock

(project counts)



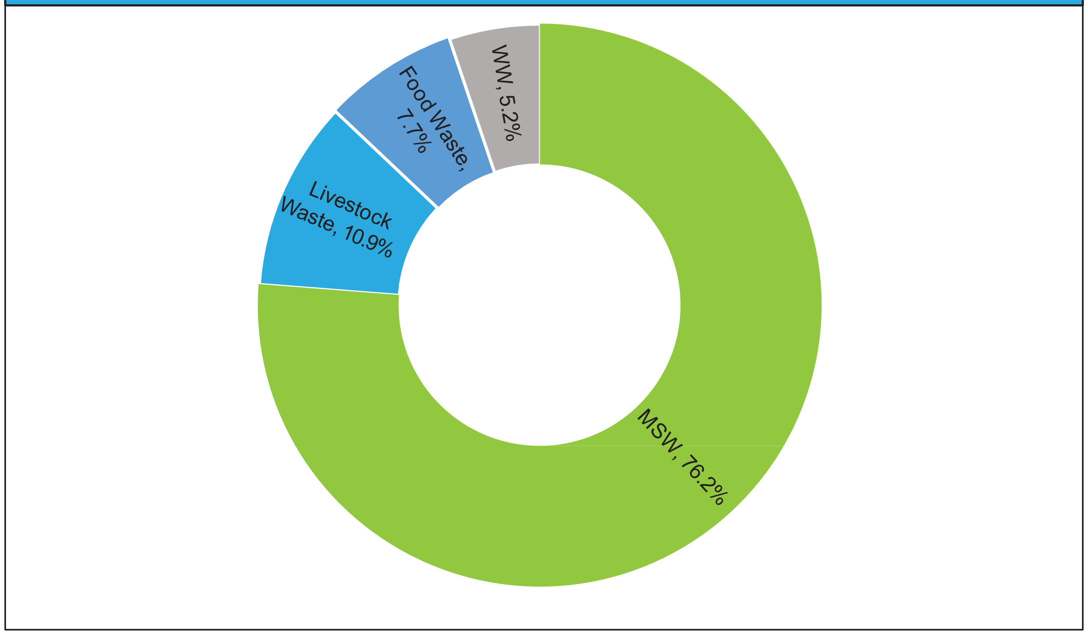
	Food Waste	WW	Livestock Waste	MSW	Total
Operational	13	23	70	72	178
Under Construction	4	14	105	14	137
Planned	5	8	35	35	83
Total	22	45	210	121	398

[7] 2021 RNG volumes and operational facility data are provided by the RNG Coalition

1 RNG Overview: The Vast Majority of RNG Comes from Municipal Solid Waste

Nearly 74 trillion British thermal units (BTU) of biomethane will be produced from waste in 2021. Of this, three quarters could come from municipal solid waste.[8]

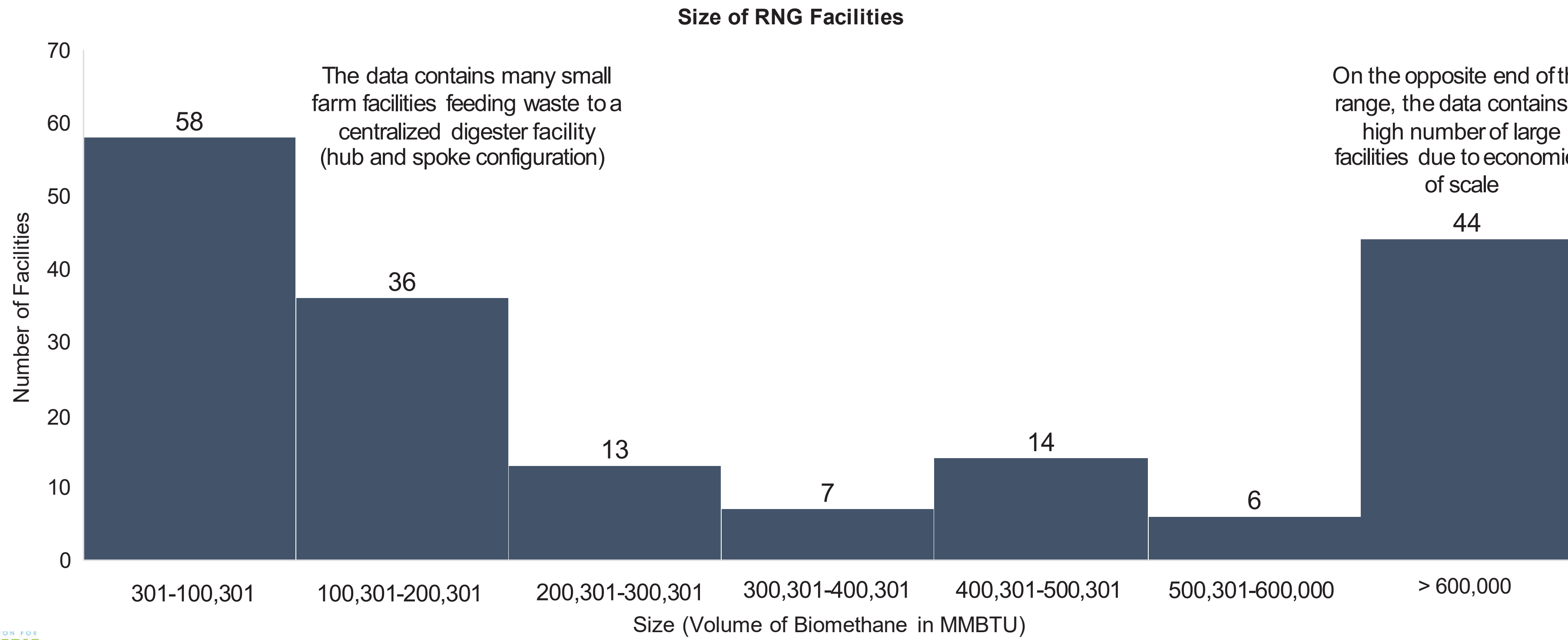
2021 RNG Volume by Feedstock



[8] Data provided by the RNG Coalition and the Argonne National Laboratory (ANL)

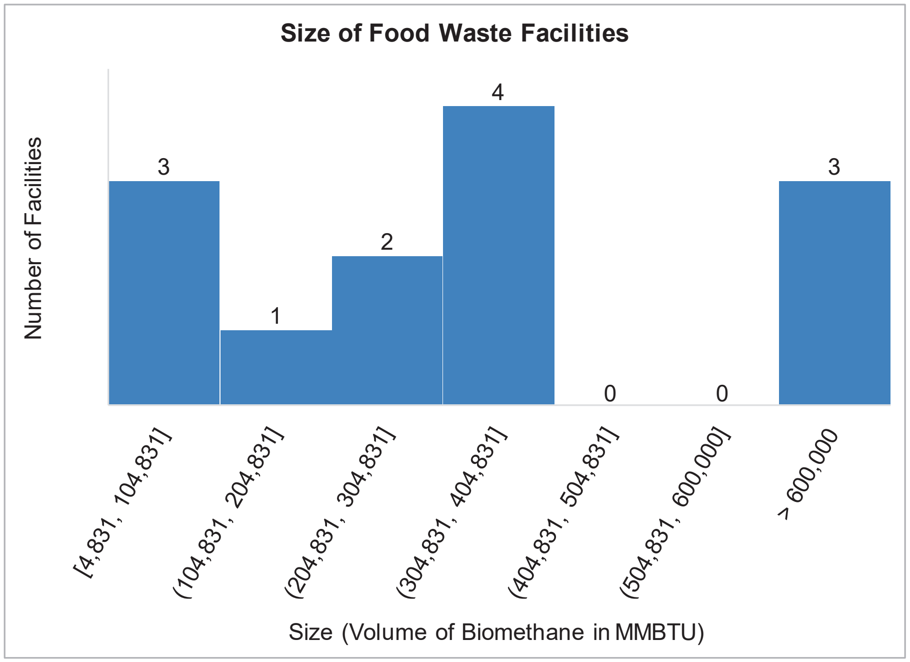
1 RNG Overview: RNG Facilities Vary in Size

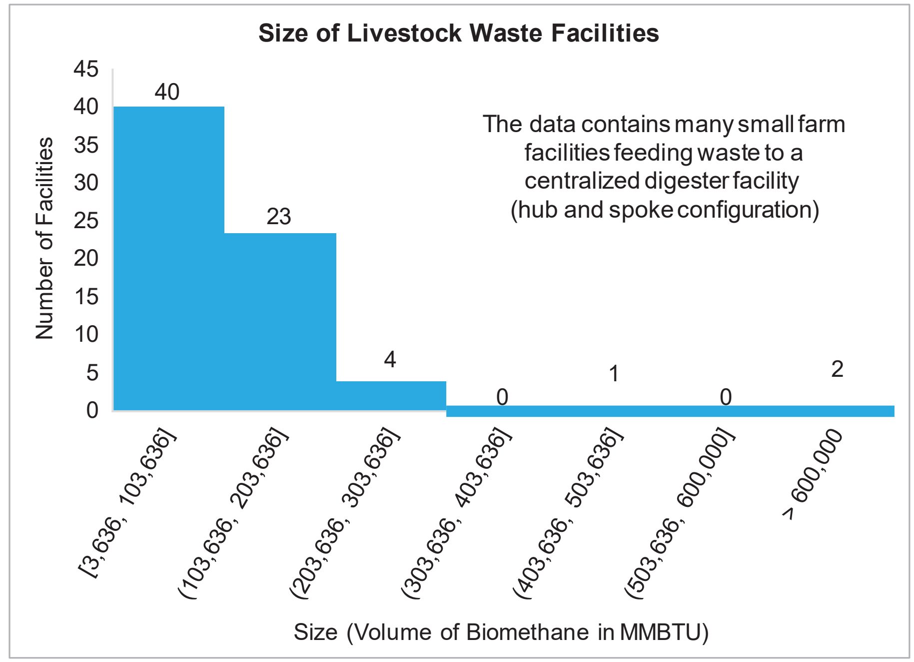
The distribution of the size of RNG facilities looks like an inverse normal distribution because of two reasons; small farms use a hub and spoke configuration for the disposal of agricultural waste, and – on the other end of the spectrum – larger dedicated facilities bring economies of scale at sizes greater than 600,000 MMBTU.



1 RNG Overview: Food Waste and Livestock Waste Facilities are Predominantly Smaller-Scale

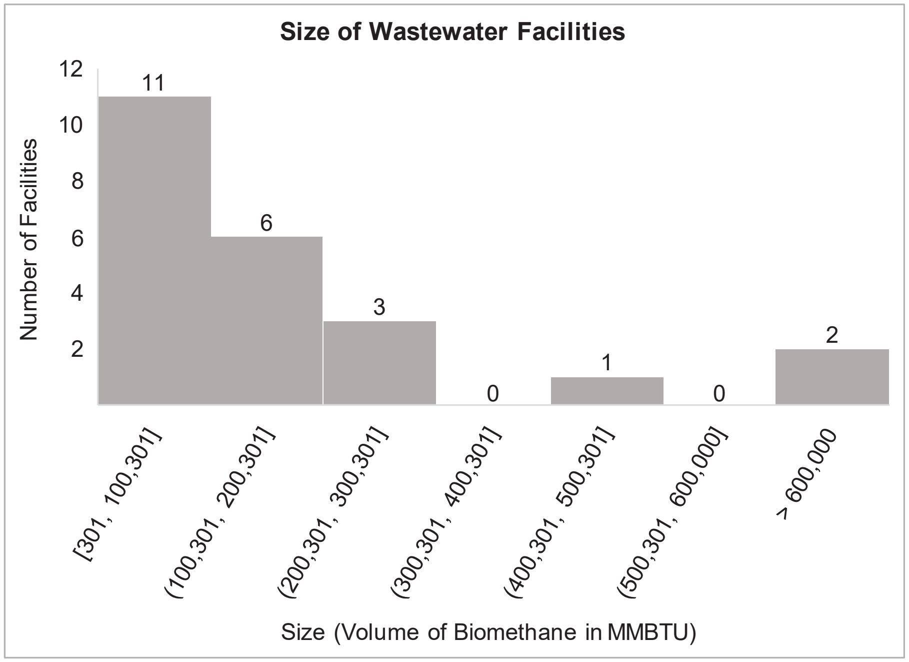
Below are the histograms for Food Waste Facilities and Livestock Waste Facilities showing the facility counts that fall within a range of MMBTU volume by feedstock. For Food Waste, facilities varied widely in size while most Livestock Waste Facilities fall within 100,000 MMBTU's of RNG.

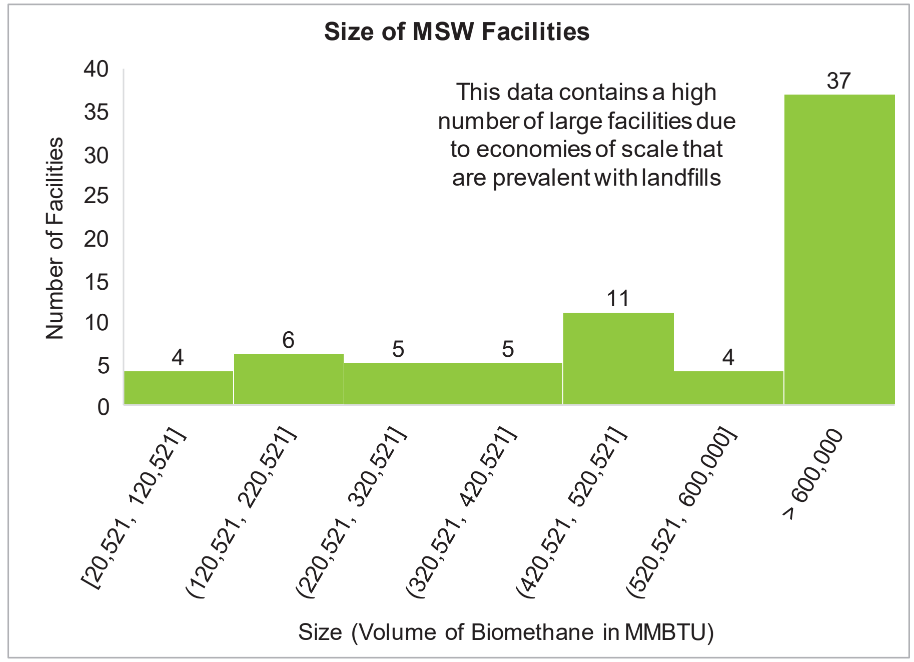




1 RNG Overview: Wastewater Facilities are Smaller in Size, MSW Facilities are Largest

Below are the histograms for wastewater facilities and MSW facilities showing the facility counts that fall within a range of MMBTU volume by feedstock. For wastewater, most facilities fall within 100,000 MMBTU's of RNG whereas the majority of MSW facilities produce over 600,000 MMBTU's of RNG.





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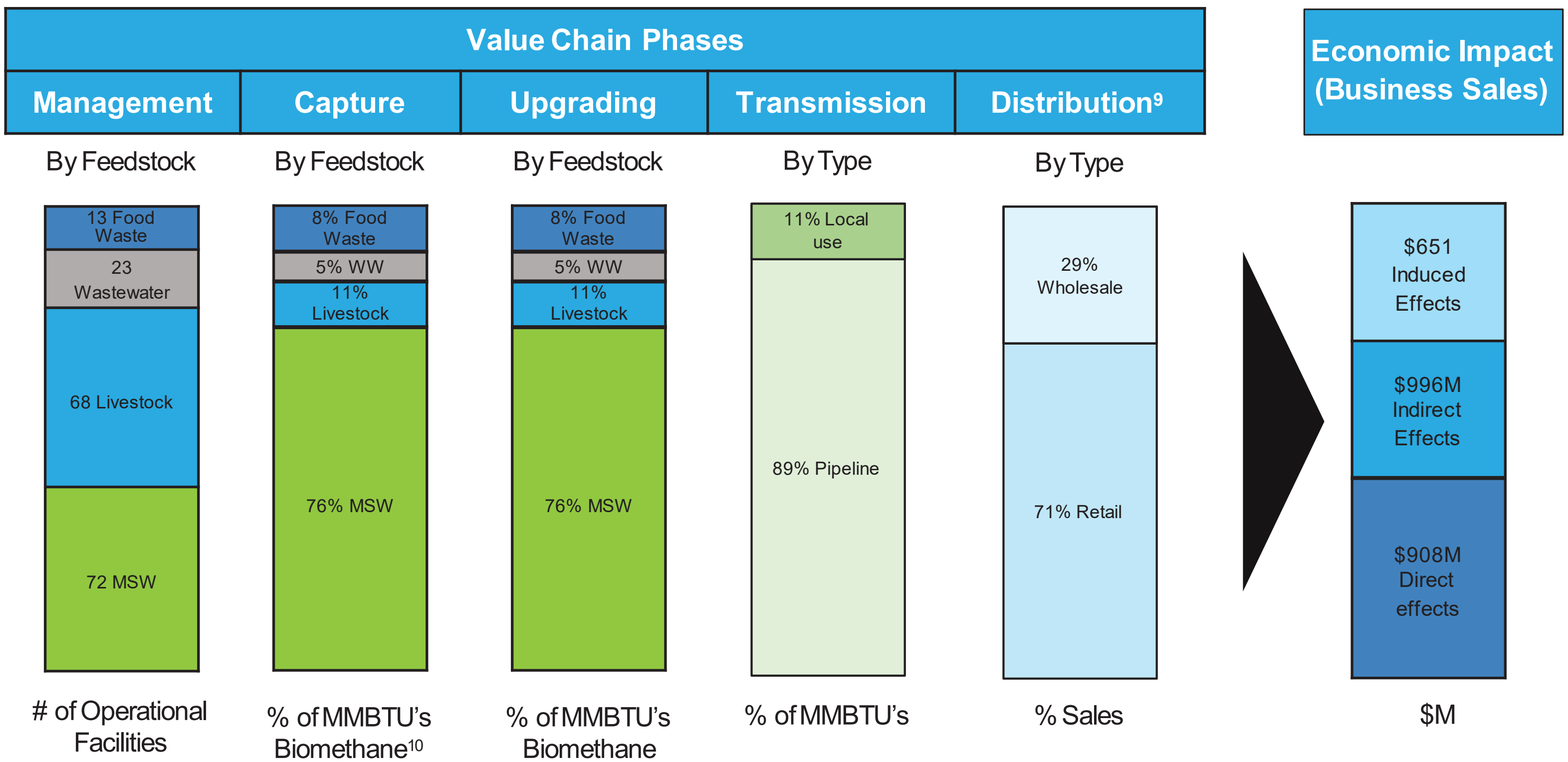
2 RNG Value Chain: The RNG Value Chain Comprises 6 Stages

Each stage of the value chain plays a role in the capture and upgrade of RNG ranging from management (waste collection) to distribution. A portion of RNG is transported via local pipeline for local usage while the remaining portion is injected into the natural gas pipeline system. The value chain is important to understanding the operation costs associated with RNG which is used to calculate its economic impact.

		Value Chain Phases					
Size	**Description**	**Management**	**Capture**	**Refinement**	**Transmission**	**Distribution**	**End Use**
Small Ops (aggregate waste to larger facility)	On/Off site anerobic digestion (hub & spoke)	Collection of waste	Anerobic digestion of waste (on-site or off-site)	Biogas is upgraded to biomethane by removing $C0_2$, H_2S, and other trace gasses	Use of local pipeline or injection of RNG into the natural gas pipeline network	Vehicle fuel is distributed to end users via local pipeline or through wholesale / retail channels	Vehicle fuel, electricity generation, home heating and industrial uses
Large Ops (on-site capture)	Onsite anerobic digestion (pipeline)		Anerobic digestion of waste (on-site)				

2 RNG Value Chain: Each Stage of the Value Chain Creates Economic Impact

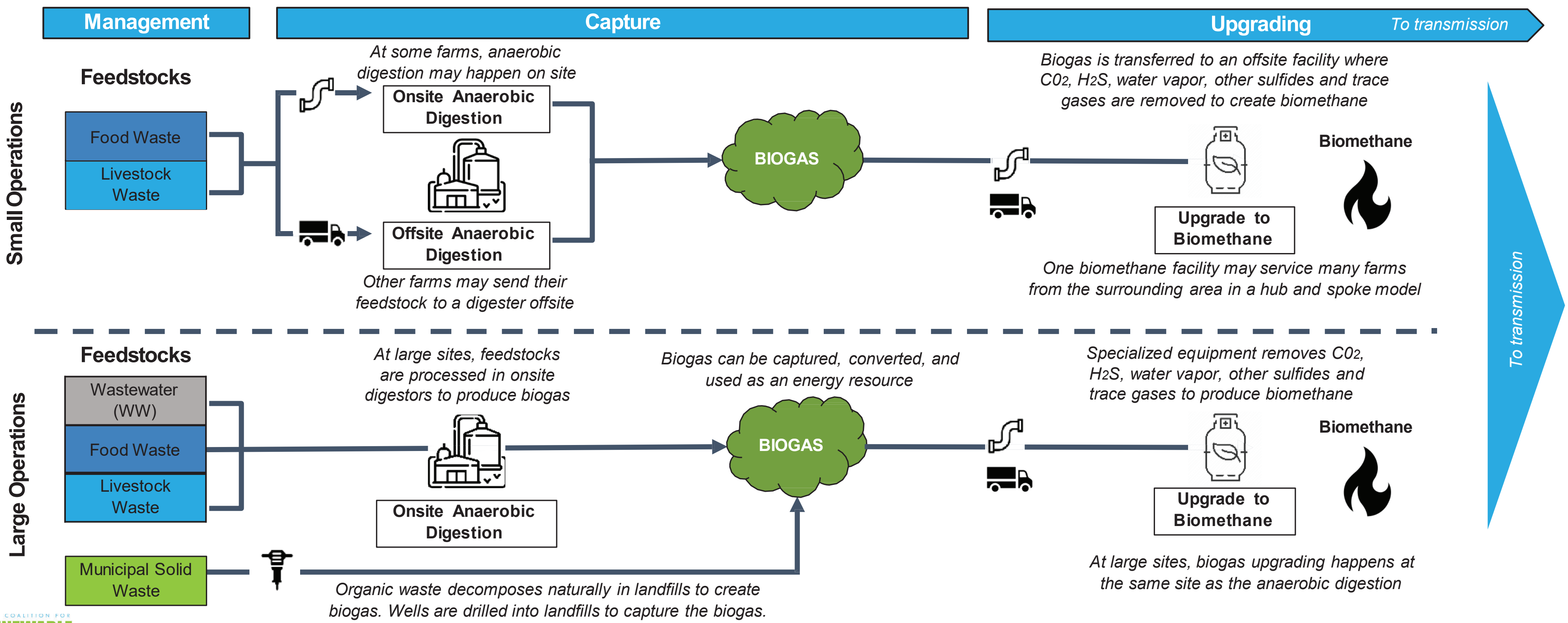
This diagram details the different components associated with each phase of the value chain and how they ultimately feed into the economic impact of the RNG industry.



[9] Distribution types for vehicle fuel
[10] RNG Coalition data only included MMBtu volumes of Biomethane

2 RNG Value Chain: Diagram Illustrates Management, Capture and Refinement Phases of Anaerobic Digestion Value Chain

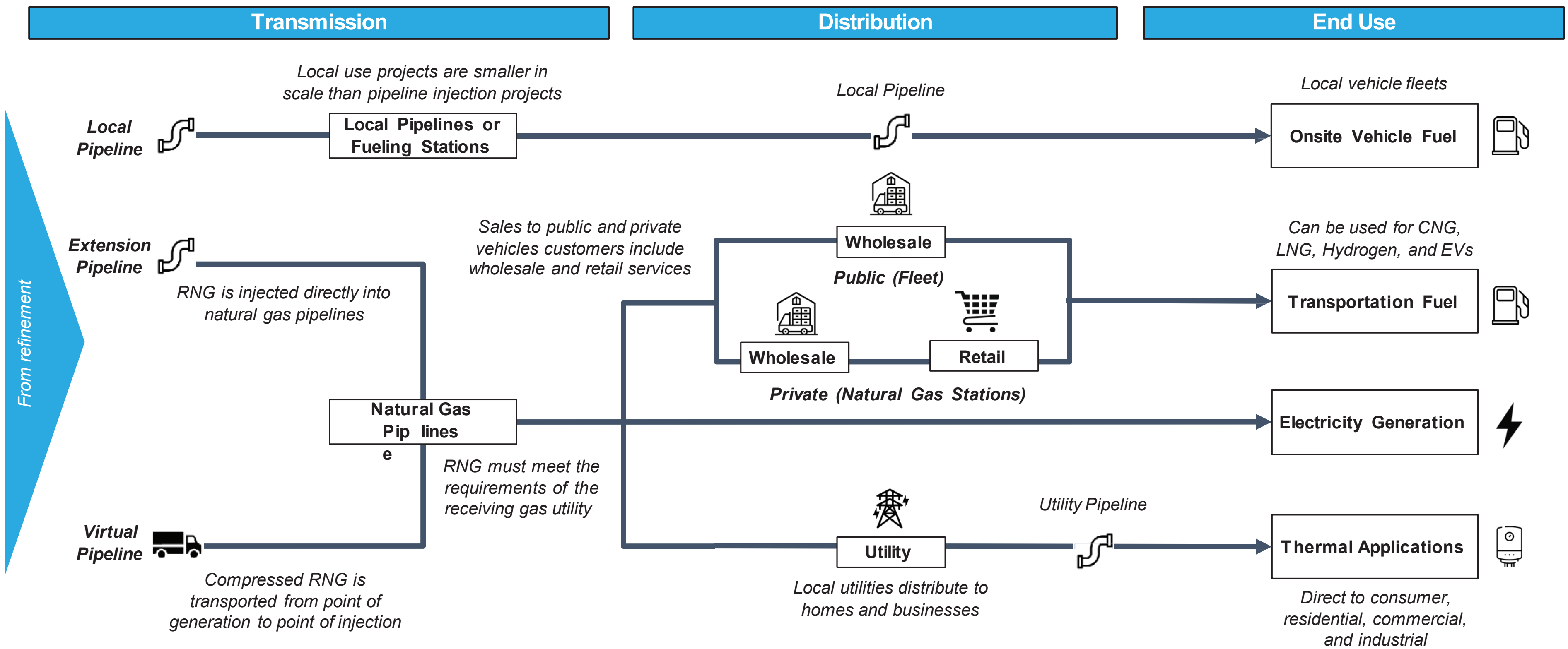
There are generally two streams for the management, capture, and refinement phases of the value chain. Many small operations must capture and refine their biogas offsite, resulting in a hub and spoke model for upgrading, while many large operations can capture and refine biogas onsite.



THE COALITION FOR RENEWABLE NATURAL GAS

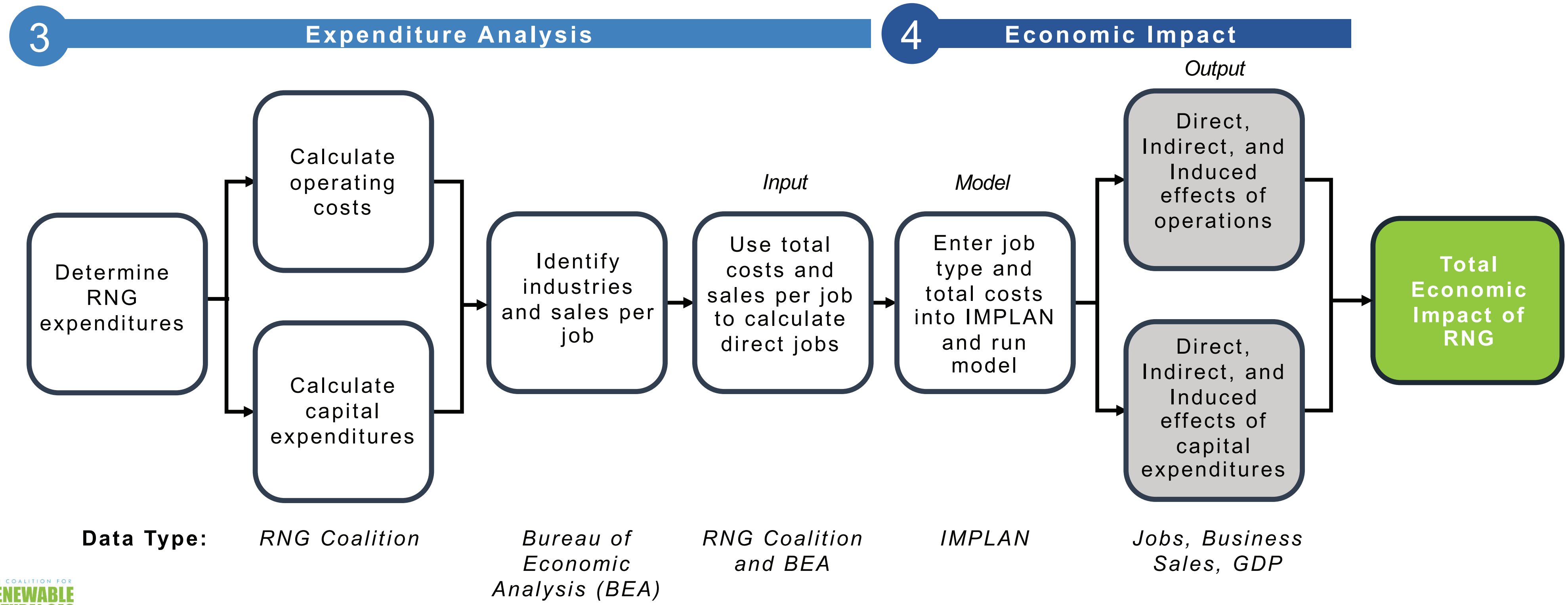
2 RNG Value Chain: Diagram Illustrates Transmission, Distribution and End Use Phases of Anaerobic Digestion Value Chain

All biomethane, whether produces onsite or at a centralized upgrading location, is transmitted through one of three ways:



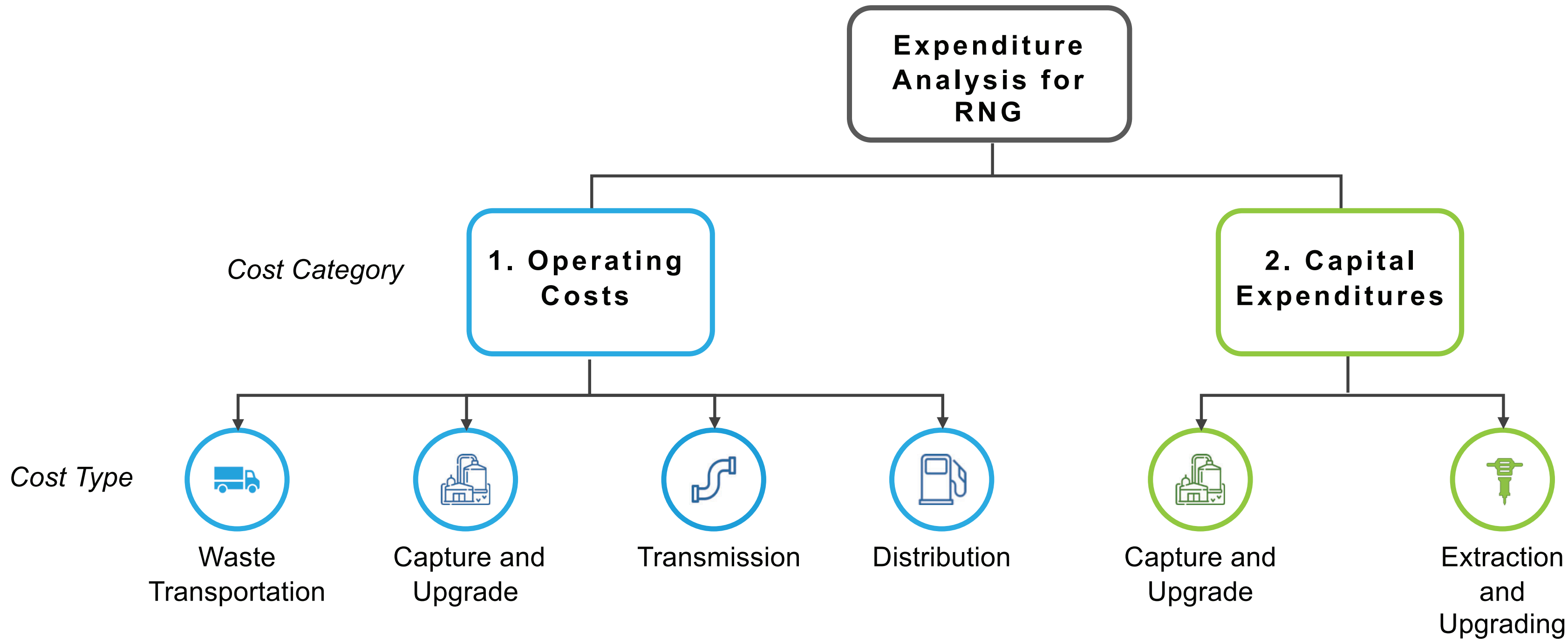
This Study Uses Input-Output Analysis Models to Analyze the Economic Impacts of RNG to the U.S. Economy in 2020

The study's primary focus is the economic impact of existing operating RNG plants and the building of new RNG plants on the U.S. economy. This analysis method is the most appropriate for this task. The diagram below illustrates the steps, outputs, and data types used to calculate the total current economic impact of RNG.



3 Expenditure Analysis: To Understand the Economic Impact of RNG, this Study First Identified its Two Major Cost Categories: 1) Operating Costs and 2) Capital Expenditures

Operating costs refer to the ongoing expenses incurred from the normal day-to-day of running of the waste transportation, capture and upgrade, transmission, and distribution phases of the value chain. Capital expenditures refers to the construction costs for the extraction, capture, or upgrade of biogas into RNG. Each cost category can be further broken into cost types as depicted below:



3 Expenditure Analysis: The First Step of the Expenditure Analysis is Understanding the Operating Costs of RNG

The first cost category for RNG is operating costs. Within operating costs, there are four types of costs that can be mapped onto the six phases of the value chain as depicted below. This diagram also provides information on the sources that were used to calculate costs for each cost type.

Operating Costs

Cost Type:	Waste Transportation	Capture and Upgrade	Transmission	Distribution
Value Chain Phase:	Management	Capture Refinement	Transmission	Distribution
Costs Source:	Tons of waste collected	1) MMBTU's of biomethane produced & 2) number of administrative jobs	Value of MMBTU's sold (market prices)	Value of MMBTU's sold (market prices)

3 Expenditure Analysis: Total Waste Transportation Costs are $13.5M

Waste collection is the first cost type within the operating costs category. Using data from the Argonne National Lab and the RNG Coalition's own data sources, transportation costs were estimated by multiplying the MMBTU's by tons of waste per MMBTU for the food waste and livestock feedstocks. Wastewater and municipal solid waste were not included in this calculation because waste collection would have occurred even without the biogas capture and upgrade process. The final transportation cost for the two feedstocks multiplies tons of waste by the cost per ton.

Waste Transportation Costs

(Transportation icon) = MMBTU (Trillion) × Tons of Waste per MMBTU[11] = Tons of Waste × Cost per Ton[12] = Transp. Costs

		MMBTU (Trillion)	Tons of Waste per MMBTU[11]	Tons of Waste	Cost per Ton[12]	Transp. Costs
Feedstock	**Food Waste**	5.6	0.48	2.7M	$1.65/ton	$4.5M
	Livestock	8.1	0.66	5.3M	$1.65/ton	$8.9M
	Total	13.7		8M		$13.5M

[11] Based on feedstock weighted average from Argonne National Labs database.
[12] Bioenergy Supply in Ireland 2015 – 2035. Sustainable Energy Authority of Ireland.

3 Expenditure Analysis: Capture and Upgrade Costs for RNG Have Two Components: 1) Costs Associated with Upgrading Biogas to RNG and 2) Associated Administrative Costs

RNG upgrading is the second cost type within the operating costs category. This slide outlines the steps taken to calculate both types of costs associated with RNG capture and upgrade.

RNG Capture & Upgrade

1. RNG Upgrading

- Identify ranges of average cost of RNG capture & upgrade per $/MMBTU
- Assign range of RNG costs to specific levels of Biomethane volume of MMBTU's
- Multiply the cost per MMBTU's times the volume for each facility

2. Administrative Costs

- Determine the number of RNG Facilities
- Add one administrative job per facility
- Sum the number of administrative jobs for all RNG facilities

3 Expenditure Analysis: The Average $/MMBTU Cost of Upgrading Biogas to RNG Ranges from $7 Per MMBTU up to $23 Per MMBTU

The first step of calculating RNG upgrading costs is determining the average $/MMBTU cost of upgrading biogas to RNG. Guidehouse identified ranges of the average cost of RNG capture & upgrade ($/MMBTU) using a variety of sources. Across all sources, costs ranged from $7 per MMBTU up to $23 per MMBTU. Guidehouse then assigned these costs ($/MMBTU) to the various volumes of biomethane detailed in the EPA report. The EPA Report provided the biogas flow output in SCFM associated with each $/MMBTU output amount. With the volume and average cost per MMBTU, Guidehouse estimated the overall RNG capture and upgrade costs for each facility, resulting in the RNG Cost/Volume Matrix.

Averaging the ranges of $/MMBTU from the reports resulted in an average cost range of $7.24 to $22.97

Sources

- WORLD RESOURCES INSTITUTE — WORKING PAPER — THE PRODUCTION AND USE OF RENEWABLE NATURAL GAS AS A CLIMATE STRATEGY IN THE UNITED STATES
- EPA United States Environmental Protection Agency
- A Report to the Washington State Legislature, December 2018 — Energy Program, Department of Commerce
- ICF — Study on the Use of Biofuels (Renewable Natural Gas) in the Greater Washington, D.C. Metropolitan Area, March 2020
- Guidehouse Proprietary Research

RNG Cost/Volume Matrix			
Biogas Output Volume Range		Costs ($/MMBTU)	Operating Costs
SCF/Min	MMBTU/Year (Biomethane)[11]	Average	Average
50	13,600	$22.97	$312.4K
100	27,200	$17.30	$470.4K
200	54,400	$12.22	$664.8K
300	81,599	$12.22	$997.1K
475	129,199	$10.63	$1,373.4K
650	176,799	$9.04	$1,598.3K
1,125	305,998	$7.45	$2,279.7K
1,600	435,197	$7.24	$3,152.1K
2,300	625,595	$7.24	$4,531.1K

[11] Guidehouse used the Argonne National Lab Methodology to convert SCFM to MMBTU/Year: SCFD *.001 * 365 *.9 = MMBTU (Assumes 1000 BTU/SCFD, 90% run time, 365 days)

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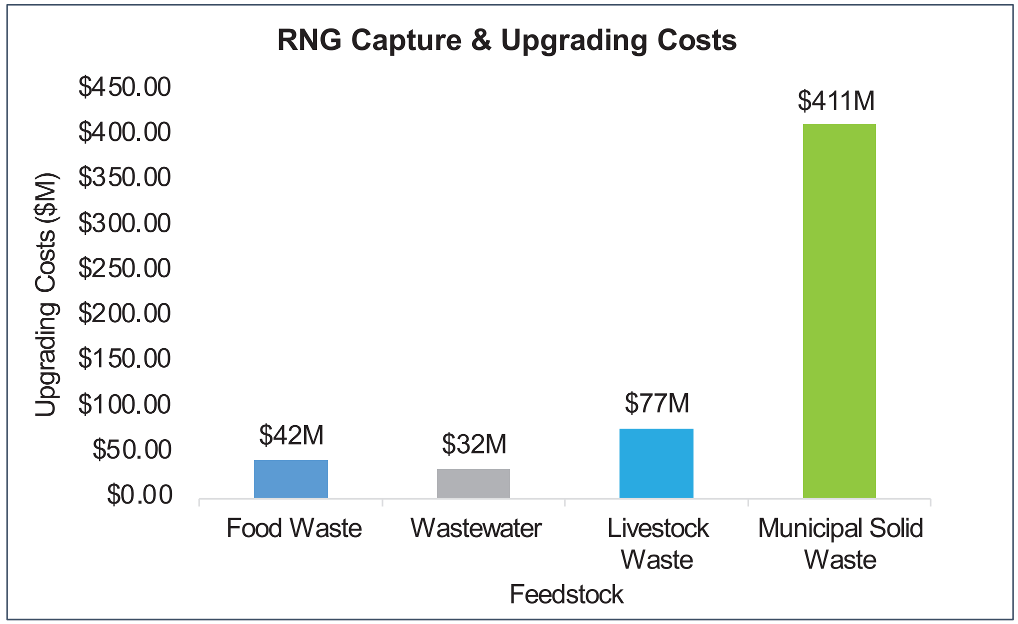
3 Expenditure Analysis: Total Cost of RNG Upgrading is $561.8M

Guidehouse used the RNG Cost/Volume Matrix to estimate capture and upgrading costs by multiplying the MMBTU's produced times the $ per MMBTU for each facility and then aggregated across all feedstock types.[13] These values represent the costs of capturing the biogas and upgrading it into biomethane.

Total Cost of RNG Upgrading

Feedstock(s)	Volume (MMBTU/Year)	$ per MMBTU	Upgrading Costs
Food Waste	5,692,689		$42.2M
Wastewater	3,885,970		$32.3M
Livestock Waste	8,080,104	$7.24 to $22.97	$76.5M
Municipal Solid Waste	56,474,133		$410.9M
Total	74,132,896		$561.8M

Municipal solid waste has the largest volume of RNG and therefore has the highest associated costs of $410.9 million. The total cost for upgrading RNG across all four feedstocks is $561.8 million.



[13] RNG costs were calculated using the sources outlined on slide 23. Volume amounts were provided by the RNG Coalition.

3 Expenditure Analysis: The Total Administrative Costs for RNG Capture and Upgrade are $12.6M

The second cost component for capture and upgrade is administrative jobs. These jobs include overseeing financial transactions, bookkeeping, transactions, and other needed support. To account for these activities, Guidehouse estimated 1 administrative job per facility based on guidance from the RNG Coalition. Assuming an average income of $72k per admin job (U.S. Bureau of Economic Analysis) Guidehouse then estimated the total administrative costs for each feedstock.

Total Administrative Costs					
Feedstock(s)	**Number of Facilities**	**Admin Jobs per Facility**	**Number of Admin Jobs**	**Sales Per Job[14]**	**Total Admin Costs**
Food waste	13	1	13	$71,642	$0.9M
Wastewater	23	1	23	$71,642	$1.6M
Livestock	68	1	68	$71,642	$4.9M
Municipal Solid Waste	72	1	72	$71,642	$5.2M
Total	176		176		$12.6M

[14] Average wage for office and administrative support (BEA)

3 Expenditure Analysis: Adding Upgrading Costs and Administrative Costs Together, the Total Cost for RNG Capture and Upgrade for All Four Feedstocks is $574.4M

This diagram shows RNG capture and upgrade costs combined. RNG upgrading costs are added to total administrative cost for reach feedstock to determine the total cost.

RNG Capture and Upgrade Costs

Input		Capture and Upgrade Costs		Total Cost
Feedstock(s)	**Volume (MMBTU/Year)**	**1 RNG Upgrading Costs**	**2 Total Admin Costs**	**Total Cost of Capture and Upgrade**
Food Waste	5,692,689	$42.2M	$0.9M	$43.1M
Wastewater	3,885,970	$32.3M	$1.6M	$33.9M
Livestock	8,080,104	$76.5M	$4.9M	$81.4M
Municipal Solid Waste	56,474,133	$410.9M	$5.2M	$416.1M
Total	74,132,896	$561.8M	$12.6M	$574.4M

3 Expenditure Analysis: The Total Cost of Transmission for RNG is $284M

Transmission is the third cost type within the operating costs category. Of the 74 trillion BTU's of RNG produced in 2021, 66 trillion (89%) are injected into the natural gas pipeline transmission system. Guidehouse used the U.S. Energy Information Administration (EIA) to find the natural gas pricing information for each of the final uses. Guidehouse then estimated the revenues for transmission of RNG using natural gas prices by category of final use and the volume (1,000 SCF) of RNG.

Transmission

Final Use	MMBTU's[15]	% of Total	Volume (1,000 SCF)	Natural Gas Price	Sales
Vehicle (Public)	32,841,043	50%	34,056,162	$4.01	$136M
Vehicle (Private)	26,503,298	40%	27,483,920	$4.01	$110M
Electricity	5,275,053	8%	5,470,230	$3.10	$17M
Thermal	1,318,763	2%	1,367,557	$8.90	$12M
Total	65,938,157	100%	68,377,869		$276M

Definitions

Vehicles (Public) Government Agency Fleets

Vehicles (Private) Retail Natural Gas Stations

[15] Adjusted for only pipeline volume

3 Expenditure Analysis: The Total Cost of Distribution (Wholesale and Retail) for RNG is $34.1M

Distribution is the fourth cost type within the operating costs category. Of the four final uses, sales to public and private vehicles customers include wholesale and retail services. In addition to the transmission sales, wholesale (4%) and retail (22%) markup percentages were applied to account for distribution services provided. Wholesale services cost an additional $9.9M and retail services cost an additional $24.2M to get RNG to it final users (e.g., public fleets and private natural gas retail stations).

Distribution

Final Use	Sales	Wholesale margin	Wholesale Sales	Retail Margin	Retail Sales	Total Sales
Vehicles (Public)	$136M	4%	$5.5M			$5.5M
Vehicles (Private)	$110M	4%	$4.4M	22%	$24.2M	$28.6M
Total	$246M		$9.9M		$24.2M	$34.1M

Definitions

Retail Margin The margin (e.g., mark-up) added to T&D (Transmission & Distribution) sales to reflect associated retail costs

Wholesale Margin The margin (e.g., mark-up) added to T&D sales to reflect associated wholesale costs

3 Expenditure Analysis: Total Direct Jobs from Operating RNG Projects

The total costs from the four major cost categories of the value chain can be used to estimate the direct number of jobs for RNG. Total costs are divided by the industry productivity ratios (e.g., sales per job) provided by the BEA. The graphic below illustrates this calculation as well as the industries associated with the direct job counts.

Waste Transportation

Capture and Upgrade

Transmission

Distribution

Direct Effects		Sales Per Job*		Direct Jobs	Industry
$13.5M (Transportation)	÷	$235,000 / job	=	57	*Waste management*
$561.8M (Upgrading)	÷	$722,000 / job	=	778	*Misc. Chemical Product Mfg*
$12.6M (Admin)	÷	$71,642/ job	=	176	*Office Administrative Services*
$275.7M (Transmission)	÷	$974,000 / job	=	283	*Natural Gas Distribution*
$9.9M (Wholesale)	÷	$1,558,000 / job	=	6	*Wholesale – Petroleum*
$24.2M (Retail)	÷	$115,000 / job	=	210	*Retail – Gasoline Stores*
Total: $897.6M		**Total Direct Jobs**		**1,511**	

*Provided by Bureau of Economic Analysis

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3 Expenditure Analysis: Understanding RNG Capital Expenditures

The second cost category for RNG is capital expenditures. There are two capital expenditures types: 1) Capture and Upgrade and 2) Extraction and Upgrade. These type of costs vary depending on the type of feedstock.

Capital Expenditures

	Capture & Upgrade		Extraction and Upgrade	
Cost Type:	Capture & Upgrade		Extraction and Upgrade	
Feedstock:	Food Waste Livestock Waste Wastewater	Food Waste, Livestock Waste, and Wastewater require an anaerobic digestor to capture biogas. The biogas is then conditioned and upgraded into biomethane.	MSW	MSW at landfills requires pumps and wells to capture (extract) the biogas created by decomposing organic waste. The biogas is then conditioned and upgraded into biomethane.

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3 Expenditure Analysis: Total Capital Expenditures is 1.03B

For food waste, livestock waste, and wastewater, capturing and converting biogas into biomethane requires a digester and upgrading facilities. For municipal solid waste, the landfill acts as the digester and collection pipes are installed in the landfill cap to extract the biogas that naturally is generated. Construction costs for each expenditure type were multiplied by the volume of gas for each feedstock.

Capture and Upgrade

Extraction and Upgrading

Feedstock	Expenditure Type	Expenditure ($)
Food Waste	Capture (Digester) and Upgrade	$129.2M
Livestock Waste	Capture (Digester) and Upgrade	$385.5M
Wastewater	Capture (Digester) and Upgrade	$101.6M
Municipal Solid Waste	Extraction and Upgrade	$413.6M
Total		$1.03B

Definitions

Capture and Upgrade — The cost of capture via anaerobic digester and biomethane upgrading

Extraction and Upgrade — The cost of capture via wells and biomethane upgrading

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3 Expenditure Analysis: Using RNG Capital Expenditure Costs, We Can Estimate an Additional 5,576 of Direct Jobs

Total capital expenditures across all feedstocks amount to over $1.03B. To estimate the direct number of construction jobs, the costs are divided by the industry productivity ratios (e.g., sales per job) provided by the BEA (within IMPLAN). The graphic below illustrates this calculation as well as the industries associated with the direct job counts. Total direction construction jobs amount to 5,576 assuming one year of construction.

	Direct Effects		Sales Per Job*		Direct Jobs	Industry
Capture and Upgrade	$616M (Capture & Upgrading)	÷	$158,608 / job	=	5,090	*Construction (non-residential)*
Extraction and Upgrade	$206.8M (Extraction) $206.8M (Upgrading)	÷	$271,703 / job	=	486	*Drilling Oil & Gas well*
	Total: $1.03B		**Total Direct Jobs**		**5,576**	

*Provided by Bureau of Economic Analysis

3

Expenditure Analysis: Most Jobs Associated with RNG are High Paying [16]

Below are the average mean salaries for the industries associated with each cost category.[17]

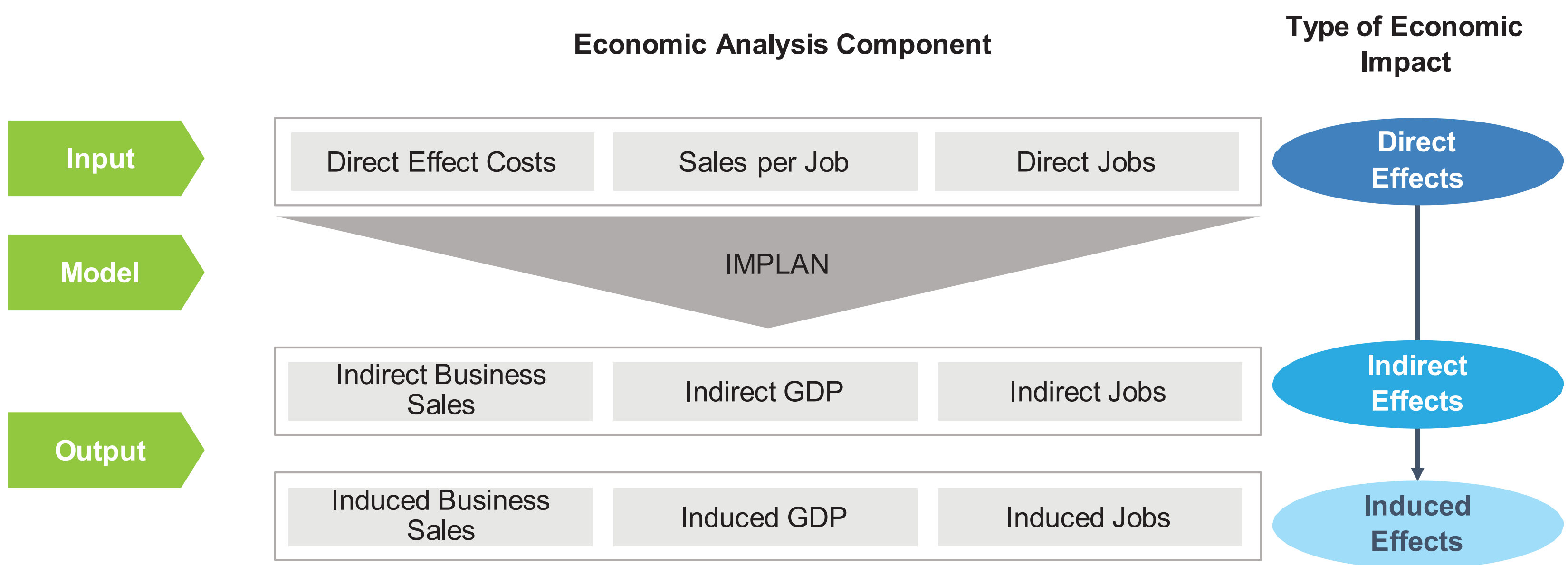
Average Wages by Cost Category

Waste Transportation	Capture and Upgrade *Operations*	Transmission	Distribution	Capture and Upgrade *Capital Expenditures*	Extraction and Upgrade
$43,290	$101,900 (Upgrading) $69,000 (Administrative)	$87,470	$63,410 (Wholesale) $67,160 (Retail)	$51,200	$58,460

[16] Based on Average Income of $36,000/yr reported by Federal Reserve of St. Louis
[17] Wages come from the Quarterly Census of Employment and Wages published by the U.S. Bureau of Labor Statistics

4 Economic Impact: The Modeling Tool IMPLAN Calculates Direct, Indirect, and Induced Effects of RNG

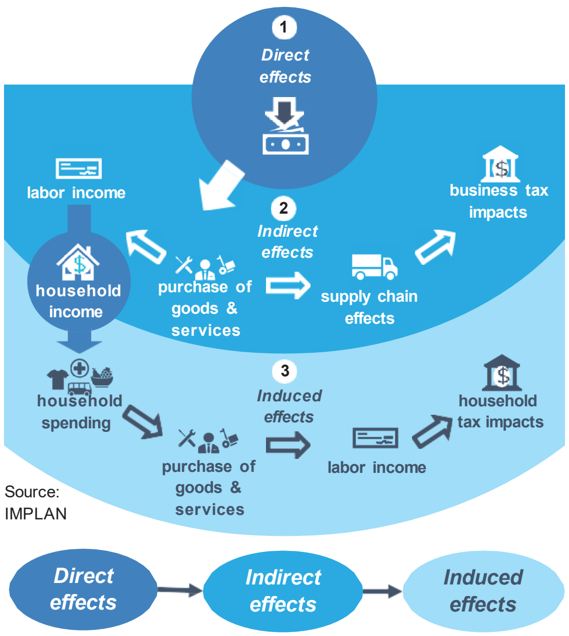
The expenditures analysis produced three values for the operating costs and the capital expenditures of RNG – RNG Business Costs, Average Sales per Job, and the Number of Direct Jobs. This information is used as inputs in the economic modeling tool IMPLAN to calculate indirect and induced effects. This modeling indicates how much additional economic activity is supported by supplier purchases (indirect) and employee spending (induced) beyond the initial RNG capture and upgrade.



4

Economic Impact: Understanding Direct, Indirect, and Induced Effects of RNG

Input-output models estimate how money moves through the economy based on supply chain relationships; the effects are categorized into direct, indirect, and induced.



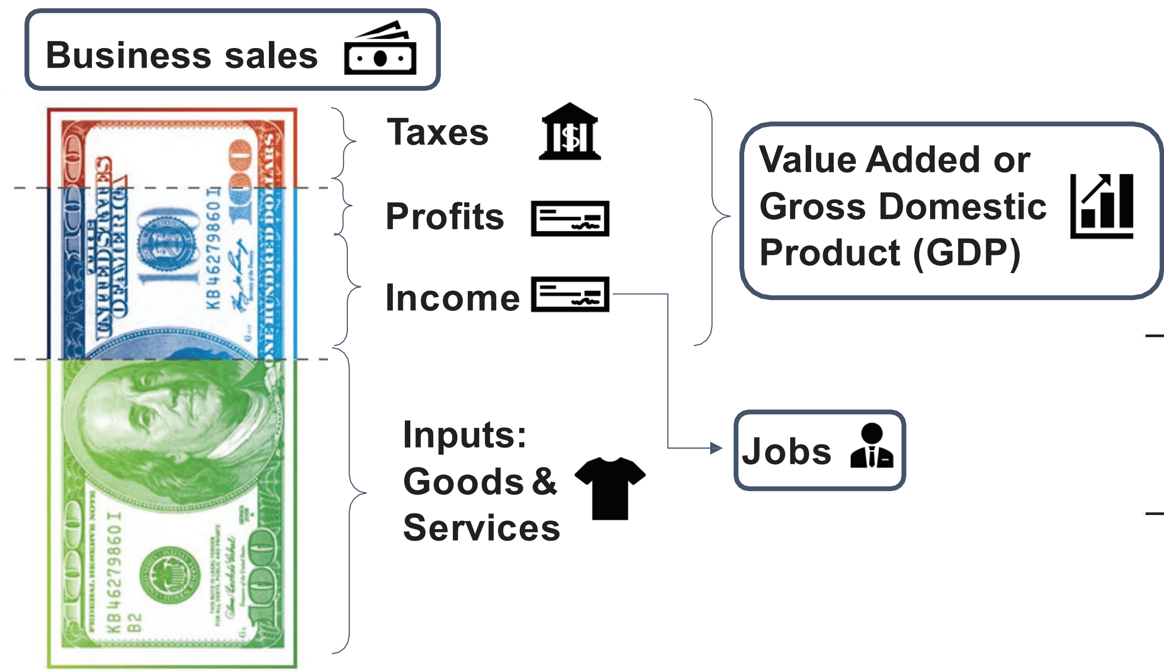
Source: IMPLAN

Type of impact	RNG Example
Direct Effects resulting from direct spending	Spending within the RNG value chain
Indirect Effects resulting from industries purchasing from each other	Spending on materials, components, and services
Induced Effects resulting from household spending of labor income	Spending on housing, healthcare, transportation, food, retail and entertainment by workers

Metrics used in this report

Business Sales	Sales of goods and services across the supply chain.
Gross Domestic Product (GDP)	The sum of the value added or 'premium' created from each stage of the supply chain
Jobs	The number of jobs created from the supply chain activity stimulated through expenditure

4 Economic Impact: Economic Impact Measures Reflect Changes in the Economy but are Subsets of One Another, Meaning They Should Not be Added Together



Taxes

Profits

\+ Income

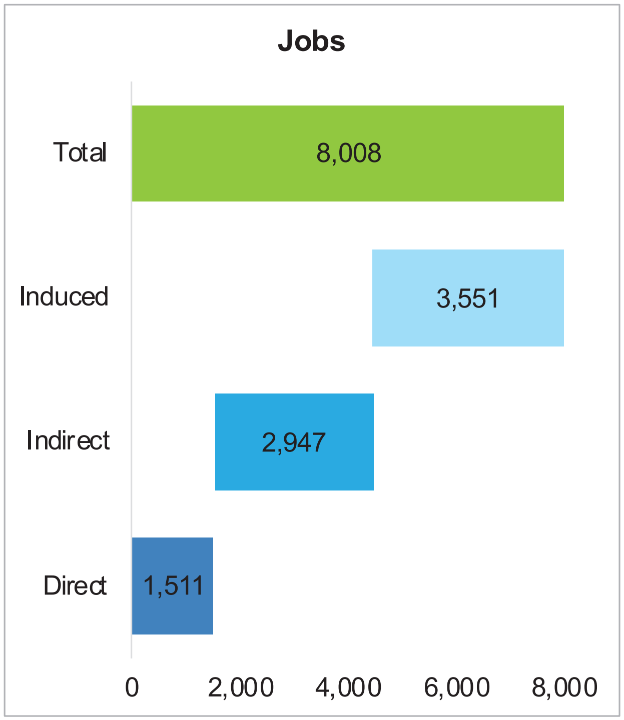
= Value Added (GDP)

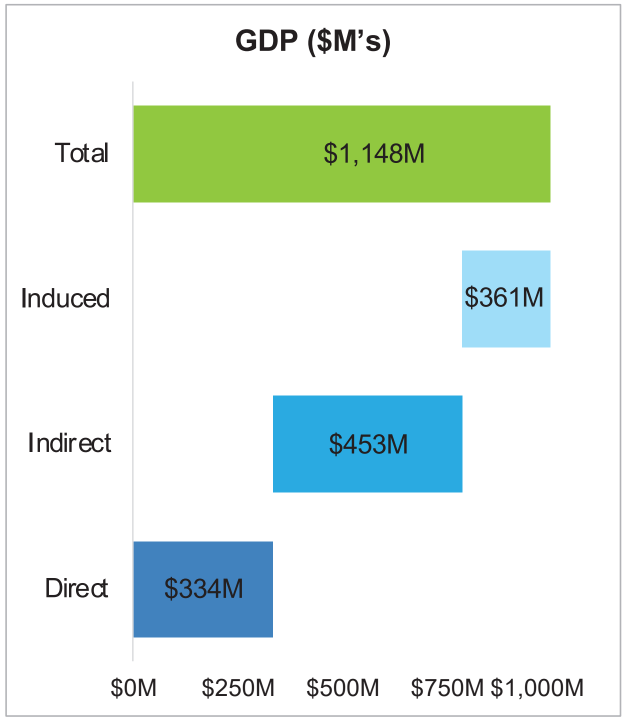
\+ Inputs

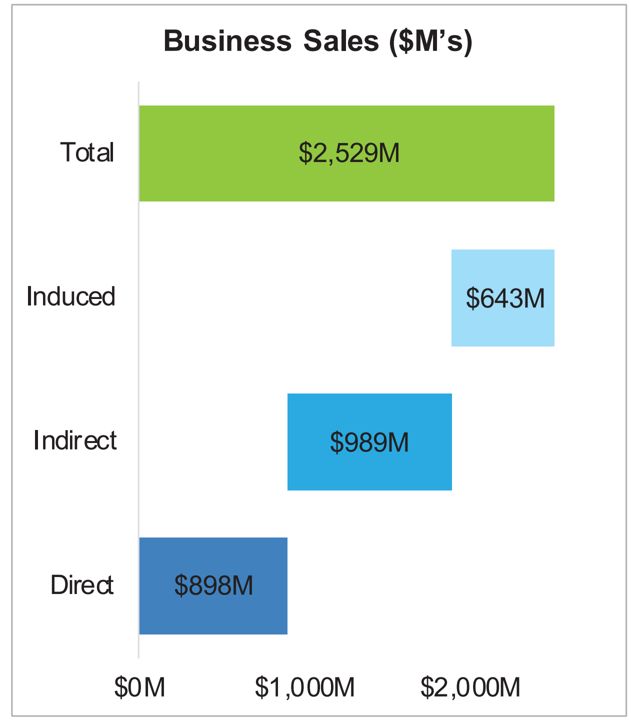
= Business Sales

4 Economic Impact (Existing Plants): RNG Operations Create 8,008 Jobs, Support $1.1B in GDP and Over $2.5B in Sales in 2021

Based on the spending for RNG operations, the direct, indirect, and induced economic impacts are presented below. Over 1,500 direct jobs are attributed to activities within the RNG value chain with a total of 8,008 jobs. In 2021, RNG supports a total of $1.1B in GDP and over $2.5B in business sales.







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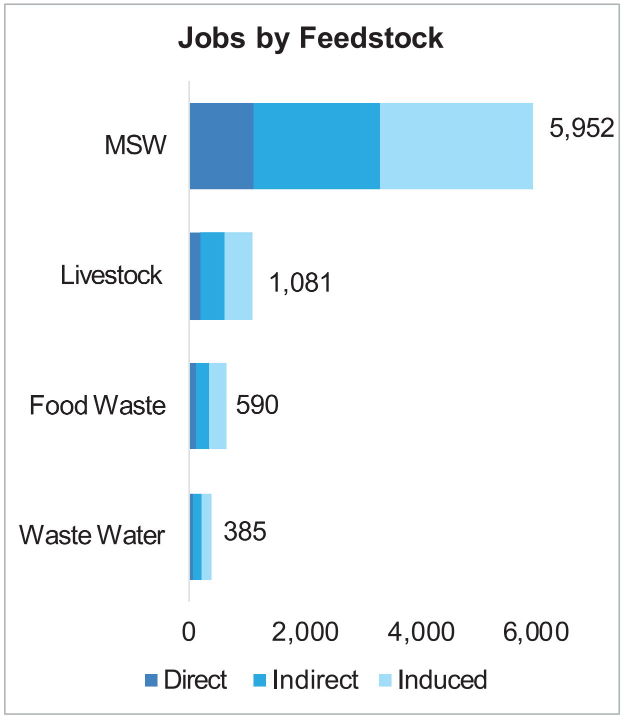
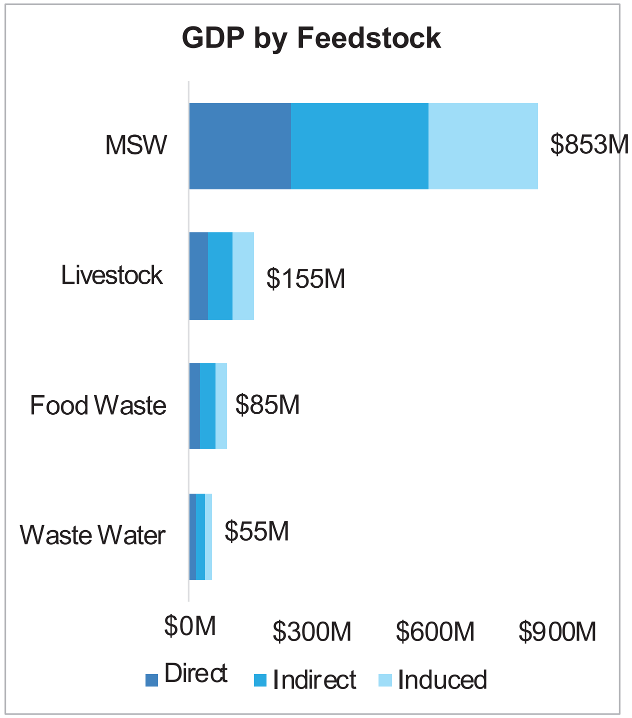
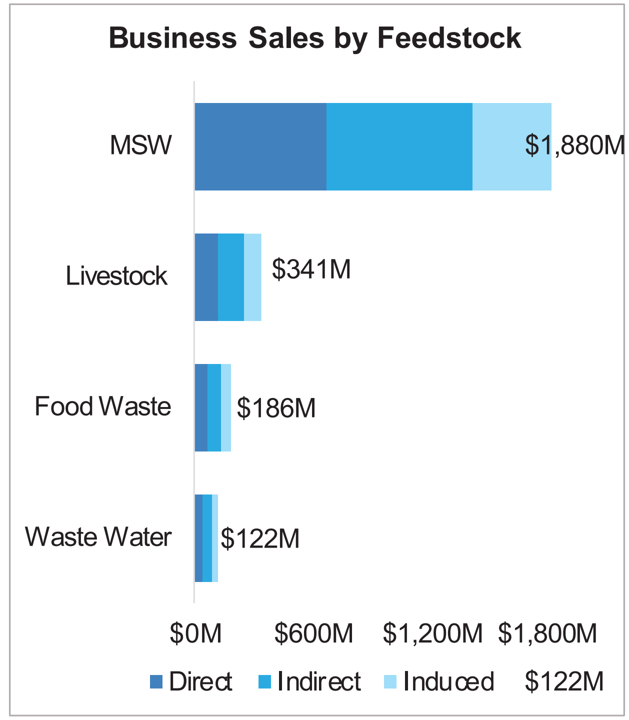
4 Economic Impact (Existing Plants): Municipal Solid Waste Has the Greatest Economic Impact from Operations of the Four Feedstocks, Accounting for 5,952 Jobs, Supporting $853M in GDP and $1,880M in Sales

The economic impacts by feedstock type are presented below with most impacts supported by RNG produced from municipal solid waste (MSW) with nearly 6,000 jobs. The remaining 27% of all jobs are spread across the other three feedstocks.







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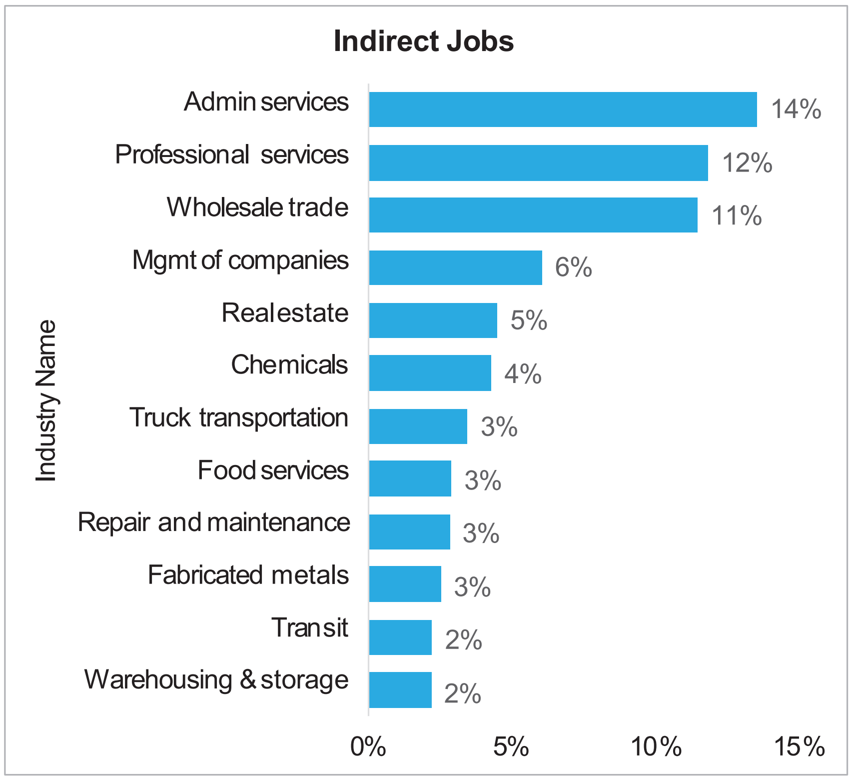
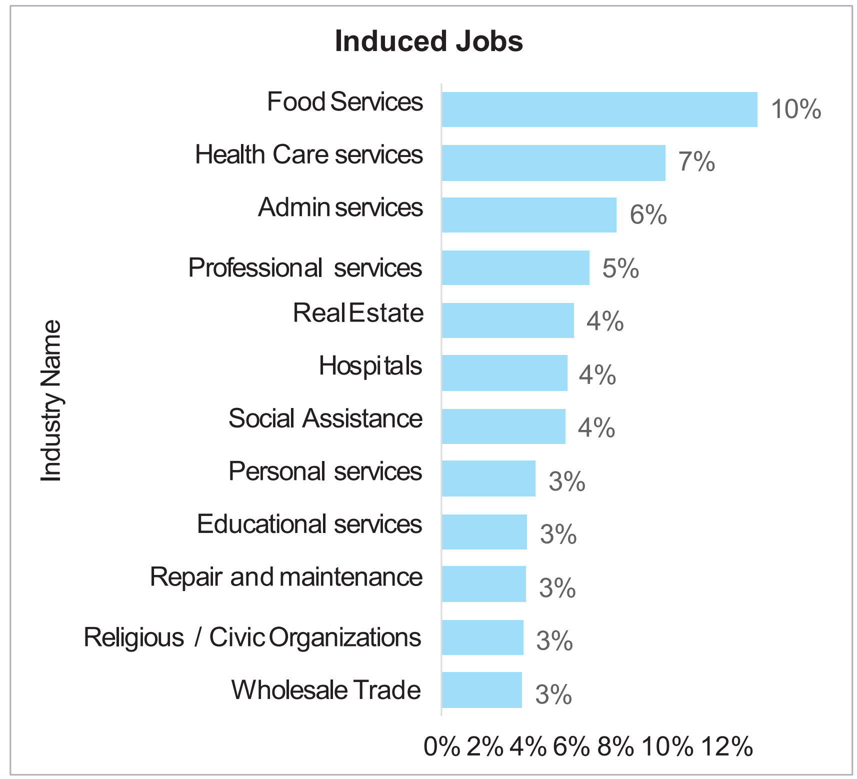
4 Economic Impact (Existing Plants): RNG Supports Jobs Across a Spectrum of Industries

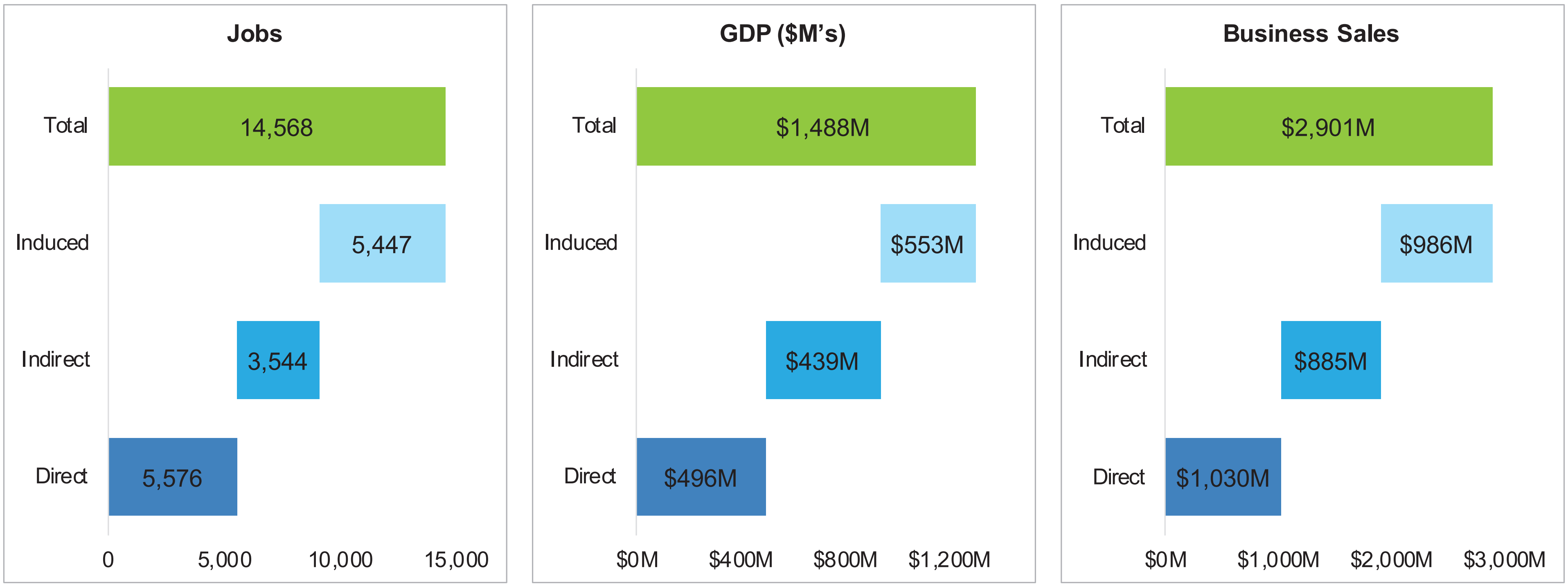
The industries with the most indirect jobs are administrative services, professional services, and wholesale trade. The industries with the most induced jobs are food services, health care services, and administrative services.





4 Economic Impact (Under Construction): RNG Capital Expenditures Create a Total of 14,568 Jobs and Support a Total of $1.5B in GDP and Over $2.9B in Sales

Based on the spending for RNG Capital expenditures, the direct, indirect, and induced economic impacts are presented below in terms of jobs, GDP, and Business Sales.



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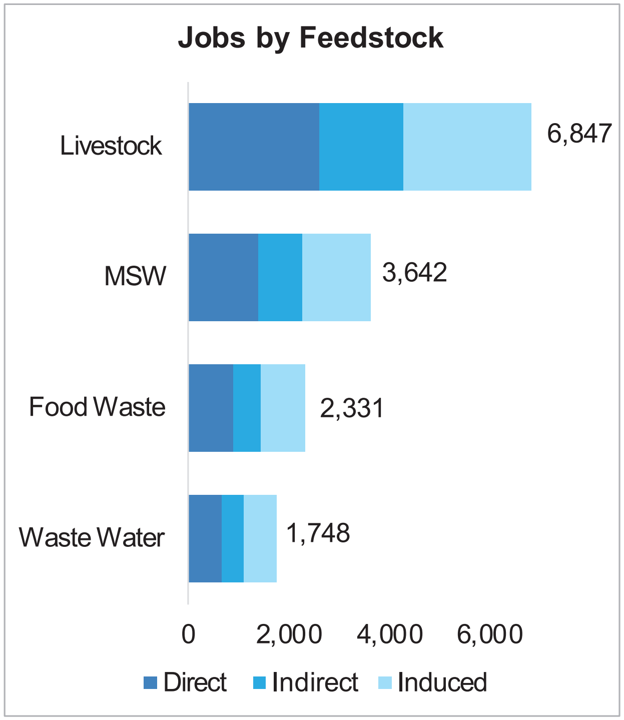
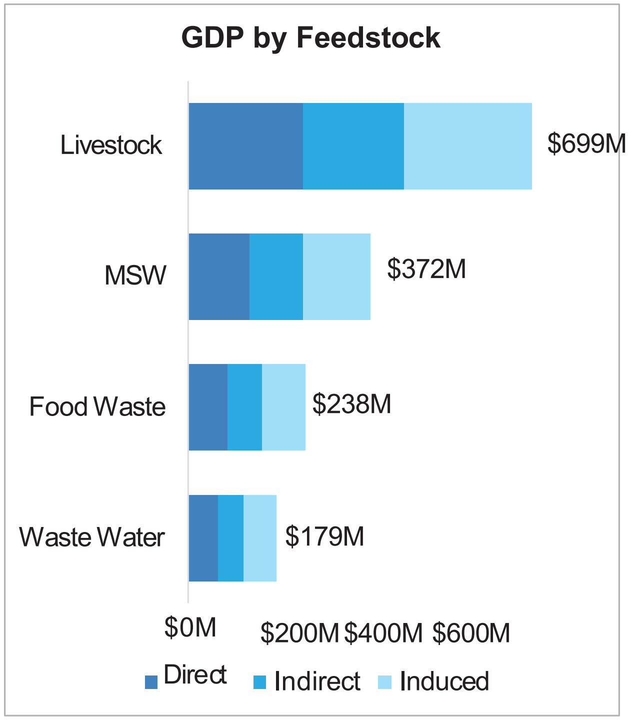
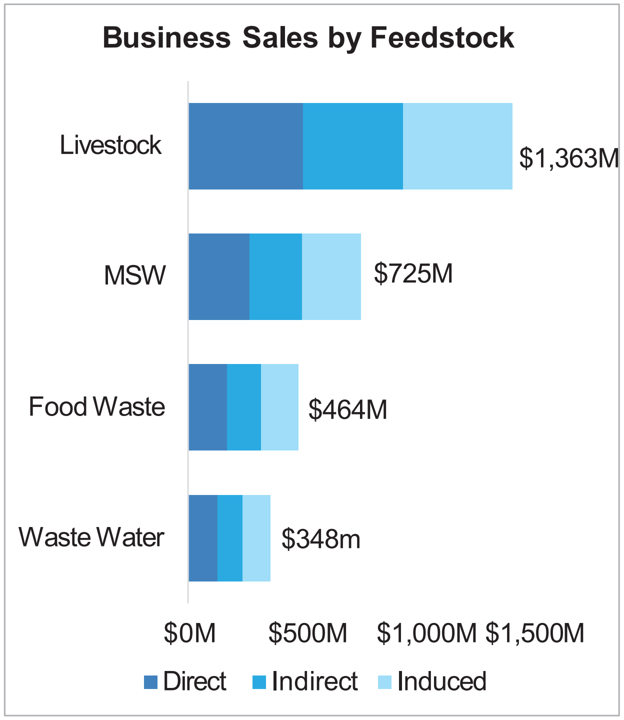
4 Economic Impact (Under Construction): Livestock Waste Has the Greatest Economic Impact from Capital Expenditures of the Four Feedstocks, Accounting for 6,847 Jobs and Supporting $699M in GDP and $1,363M in Sales

The economic impacts by feedstock type are presented below with most impacts supported by RNG produced from Livestock Waste with 6,847 jobs. The remaining 28% of all jobs are spread across the other three feedstocks.







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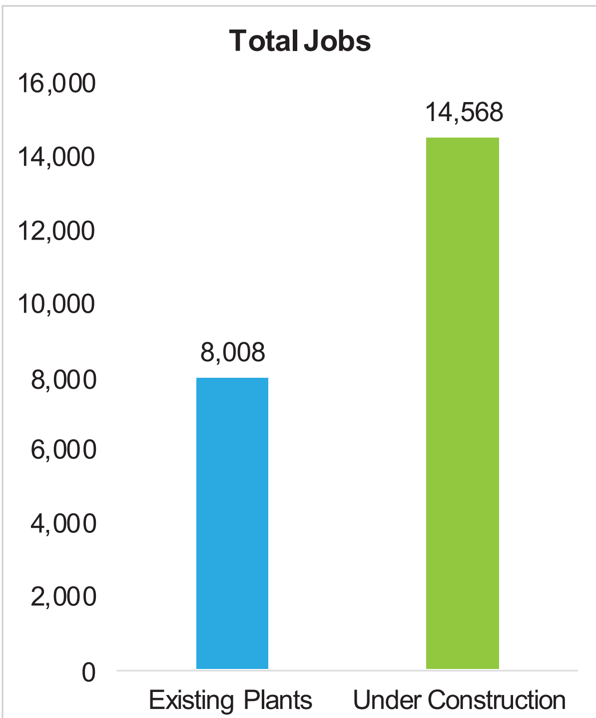
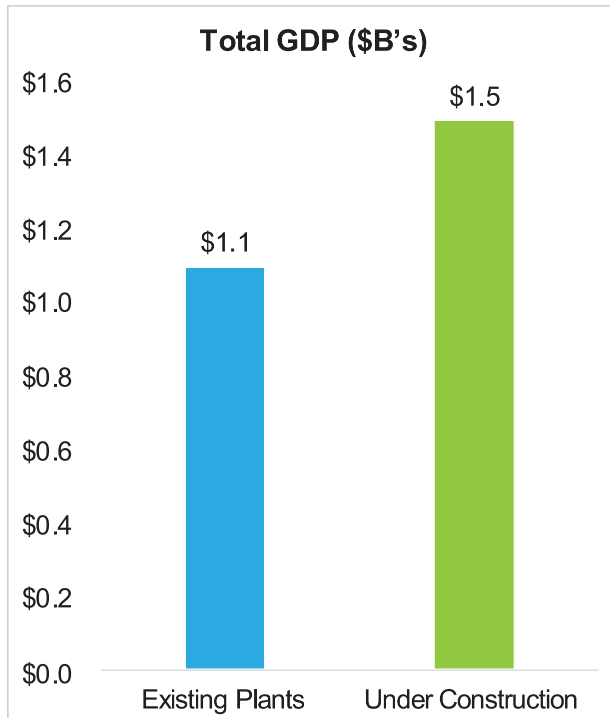
4

Economic Impact: RNG Contribution in Jobs, GDP and Total Sales

These numbers include the direct, indirect, and induced effects of RNG. Operations jobs are ongoing at completed RNG facilities; capital expenditure or construction jobs last approximately one year and are renewed as additional projects are developed in this growing industry.





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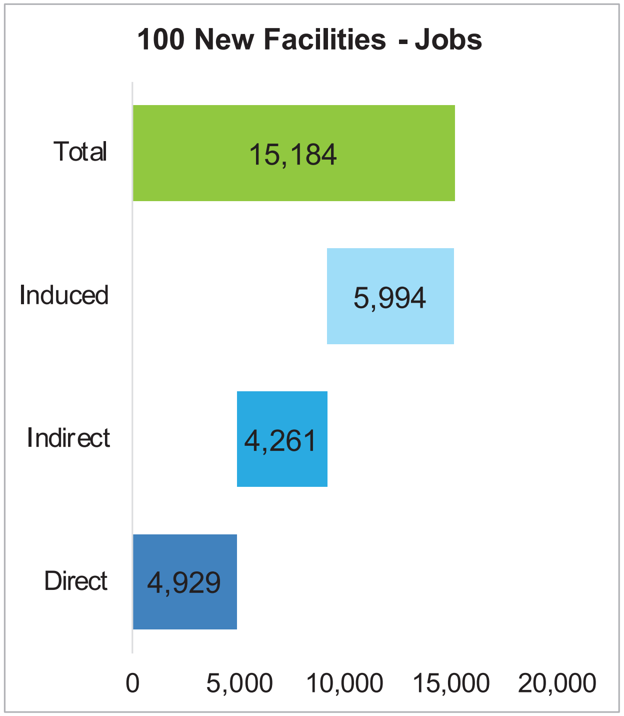
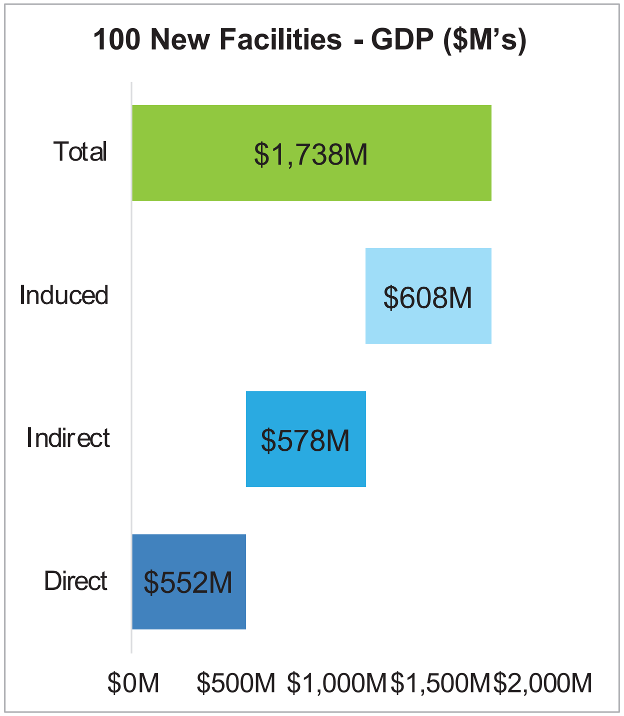
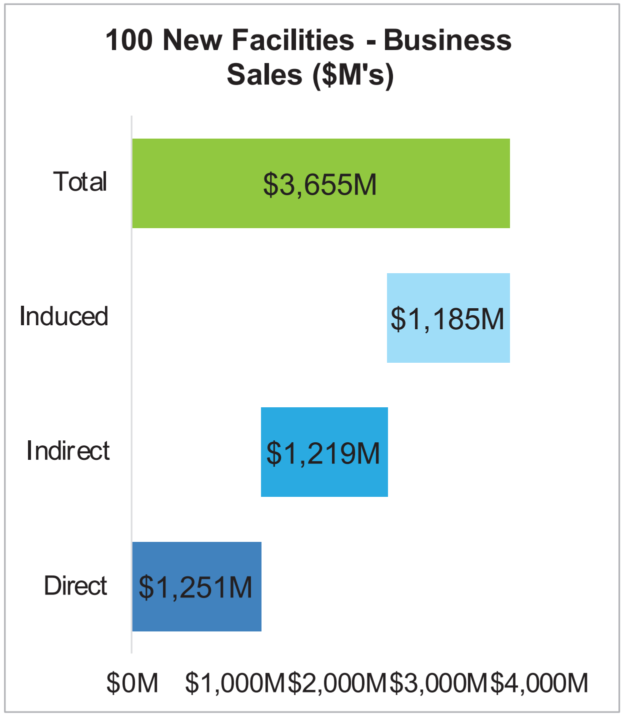
4

Economic Impact of 100 New RNG Facilities

Over 4,929 direct jobs could be attributed the construction and operations and maintenance of 100 new RNG facilities with a total of 15,184 jobs. 100 new facilities could also support a total of $1.1B in GDP and over $2.5B in business sales.[18]





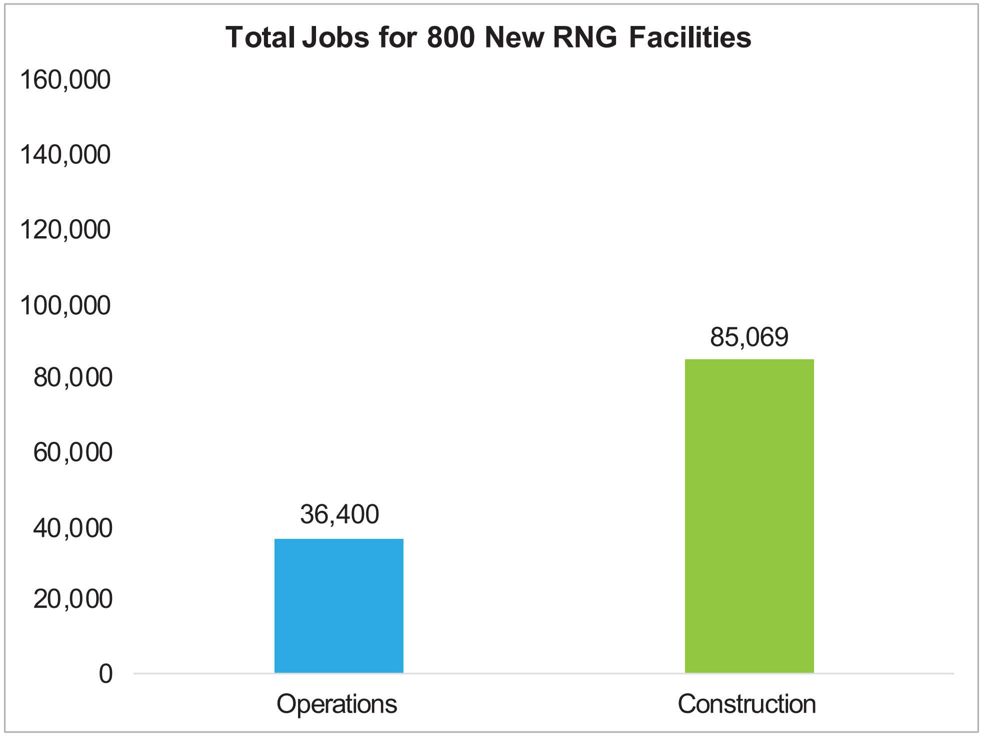


THE COALITION FOR RENEWABLE NATURAL GAS

[18] Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operational facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by the RNG Coalition.

4 Economic Impact: Projected Jobs from RNG Industry Growth by 2030

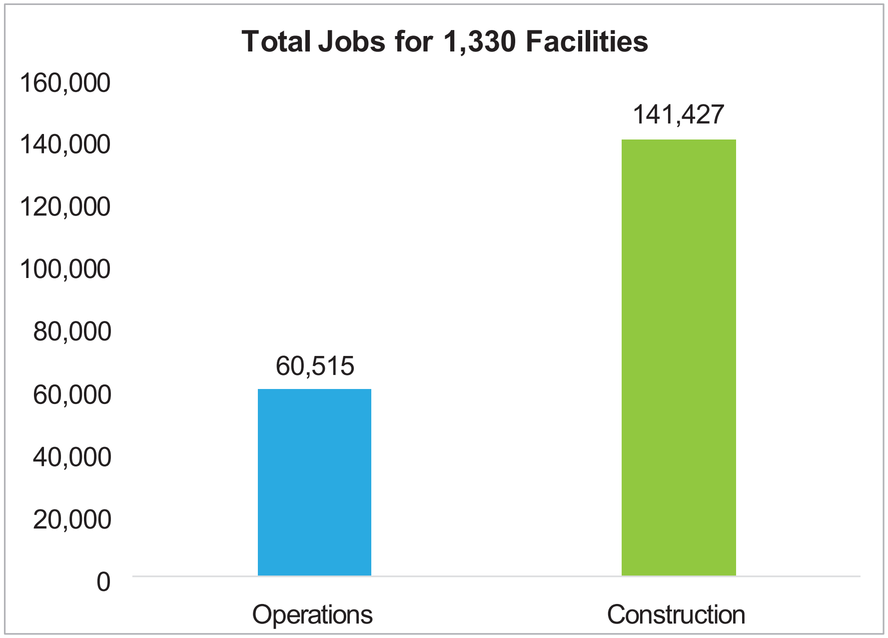
An additional 800 new facilities, the growth target for 2030 under RNG Coalition's SMART initiative, would create an estimated 121,469 total jobs.[19]



[19] Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by RNG Coalition and are based on the Sustainable Methane Abatement and Recycling Timeline (SMART Initiative) Goals. These calculations do not take into consideration yearly economic changes that might affect RNG job numbers.

4 Economic Impact: RNG Jobs Growth if U.S. Follows a Net Zero Pathway

According to the International Energy Agency's (IEA) Net Zero by 2050 scenario*, if the world follows a pathway to prevent the worst impacts of climate change, global RNG volume could increase sevenfold in the next decade. In the US, this could result in 1,330 RNG facilities. An additional 1,330 facilities would create an estimated 201,578 jobs.[20]



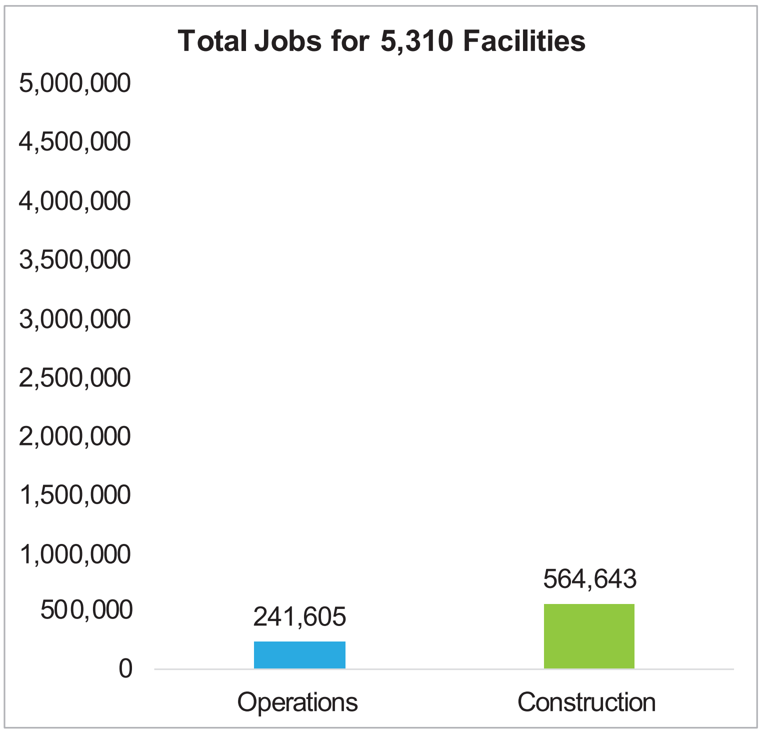
[20] Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by RNG Coalition. These calculations do not take into consideration yearly economic changes that might affect RNG job numbers.

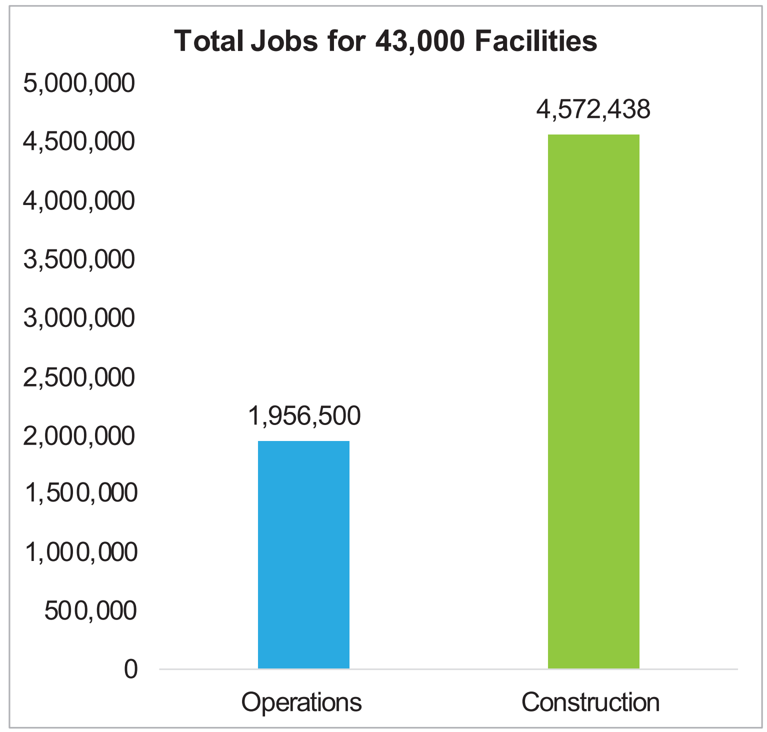
* Source: International Energy Agency, Net Zero by 2050 A Roadmap for the Global Energy Sector (2021)

4

Economic Impact: RNG Industry Jobs Growth by 2050

The IEA Net Zero by 2050 scenario estimates 5,310 new facilities by 2050, which could create an estimated 806,248 jobs. If, however, RNG reaches total buildout under the SMART Initiative, this could result in 43,000 facilities by 2050, which would create an estimate 6,528,938 jobs.[21]





THE COALITION FOR RENEWABLE NATURAL GAS

[21] Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by the RNG Coalition. This calculations do not take into consideration yearly economic changes that might affect RNG job numbers.

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THE COALITION FOR RENEWABLE NATURAL GAS

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Docket No. E-2, Sub 1293

DC Meters – Field Testing @ McAlpine Microgrid

Tom Fenimore, PE
March 31, 2021

ANSI C12.32 – DC Metering Standard – Congrats David and Team!

Presson Exhibit No. 9
Docket No. E-2, Sub 1293

NEMA (ASC C12) (National Electrical Manufacturers Association)
1300 North 17th Street, Suite 900, Rosslyn, VA 22209 p: (703) 477-9997 w: www.nema.org

New Standard

ANSI C12.32-2021, Electricity Meters for the Measurement of DC Energy (new standard) Final Action Date: 3/4/2021

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An open industry association
Leader in promoting the greater use of DC and hybrid AC/DC microgrids & power systems

DC Metering Technical Standards Committee

Chairman David Lawrence – Duke Energy

National Standards Institute recorded the final action of its C12 standards committee to approve the standard in its weekly pul
ry, Volume 52 Issue 11, wherein it simply states: "New Standard ANSI C12.32-2021, Electricity Meters for the Measurement o
ate: 3/4/2021." Committee Chairman Tom Nelson of NIST and Committee Secretary Paul Orr of NEMA oversaw months of tir
group led by Duke Energy's Charlie Ploeger who finalized the document and shepherded it through ANSI's formal vetting and a
cted to be published and available from ANSI within ninety (90) days of the action date.

:

ease by ANSI.

DC Metering Requirements – Some Background

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Docket No. E-2, Sub 1293

- DC Coupled Solar/Storage systems continue to proliferate
- Existing PPA's are typically setup for AC metered energy and power
- Revisions to existing PPA's and new PPA's can value Solar and Storage energy differently
- The only way to separate Solar and Storage energy in a DC coupled system is with DC Meters
- Currently no U.S. Utility has a Revenue Certified DC Meter!
- The need to understand DC metering, it's installation requirements and billing system integration is here, now!

McAlpine Microgrid – DC Meter Locations

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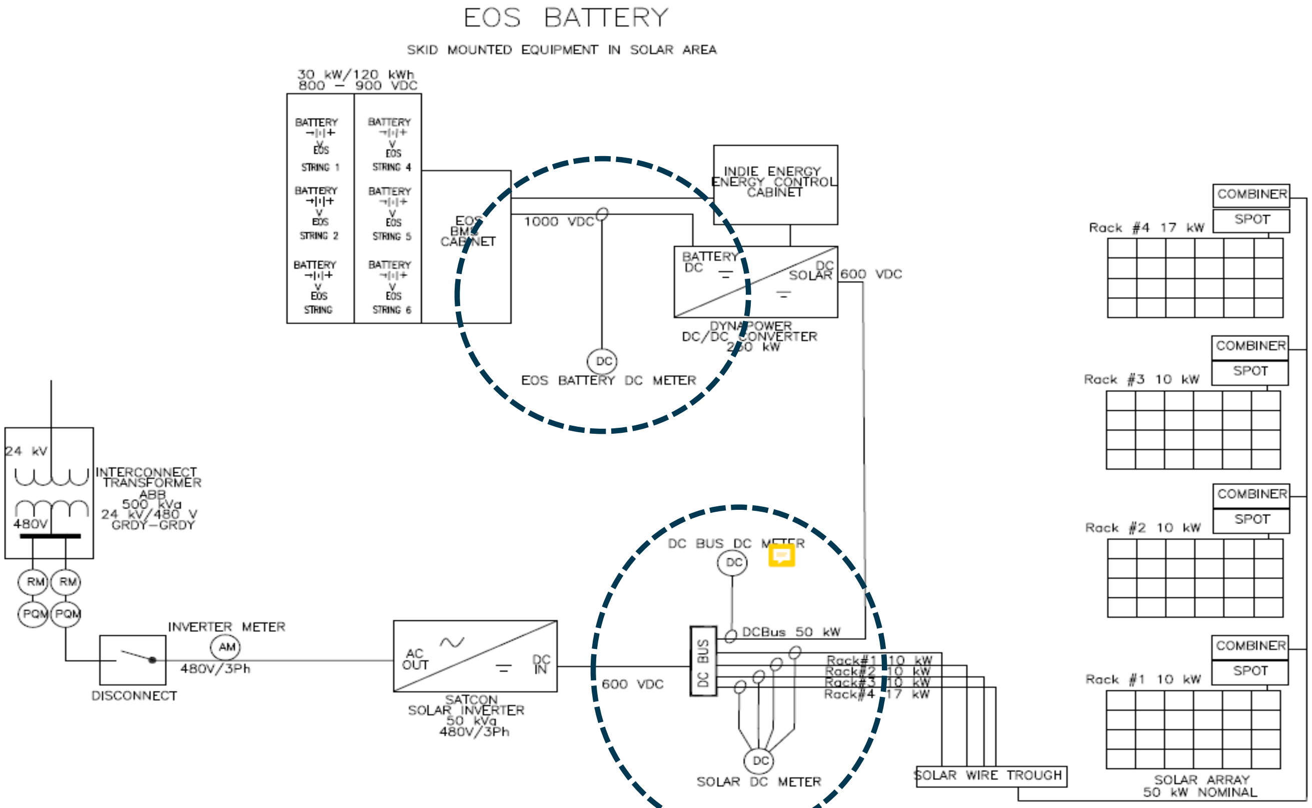
Docket No. E-2, Sub 1293

DC Bus and Battery

- Meters @ DC/DC Converter
- 2 Meters
- 1 Acculink gateway

Solar Strings

- Meters @ Satcon Inverter
- 4 Meters
- 1 Acculink gateway



McAlpine Microgrid – DC Meter Network

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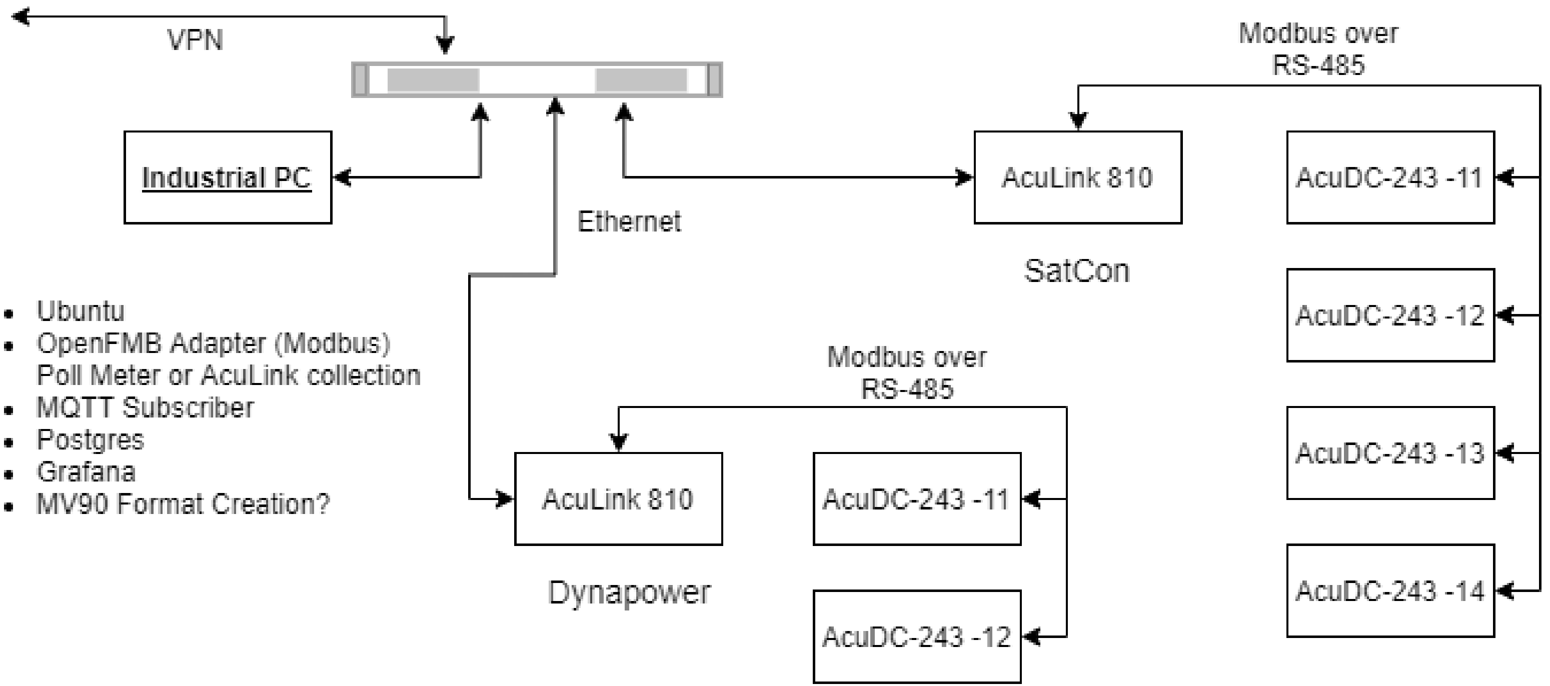

- Ubuntu
- OpenFMB Adapter (Modbus) Poll Meter or AcuLink collection
- MQTT Subscriber
- Postgres
- Grafana
- MV90 Format Creation?

McAlpine Microgrid – Solar String Meters

Accuenergy Equipment

Meters: Model 243

Acculink Gateway: Model 810

DC Shunts: 100A

McAlpine Microgrid – Battery and DC Bus Meters

Accuenergy Equipment

Meters: Model 243

Acculink Gateway: Model 810

DC Shunts: 100 A - Battery
200 A - DC Bus

100 Amp

200 Amp

McAlpine Microgrid – Grafana Screenshots of meter data

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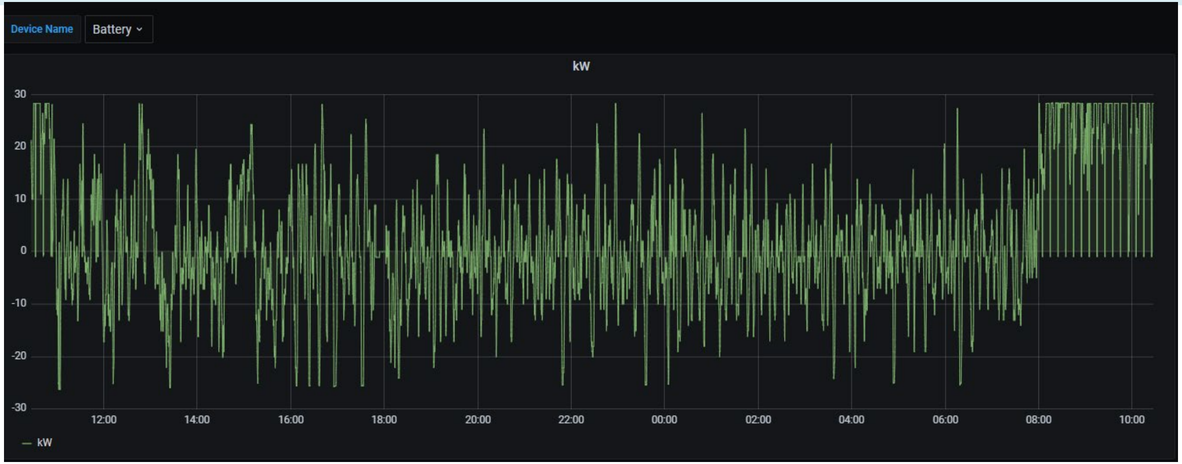

Frequency response testing of EOS battery

Battery Data

- 24 Hrs @ 1 second

DC Bus Data

- 3 Hrs @ 1 second

McAlpine Microgrid – DC Meter Testing Status As of 3/26/2021

- DC meters installed and operational
- SEL 3355 Industrial Computer installed in control house
- Existing site network utilized for IP comms
- Palo Alto Firewall & Cell modem for access with VPN

- AccuLink Mosquitto MQTT publishes log data @ 1 second rate in JSON format
- SEL3355 subscribes to AccuLink published traffic
  - Stores JSON formatted data into the Postgres database
  - Data is available for viewing with Grafana

- Ready for Billing System Integration

McAlpine Microgrid – DC Meter Testing Observations

Presson Exhibit No. 9
Docket No. E-2, Sub 1293

- DC meters are more like Transducers & SCADA devices than Utility Meters
- DC shunts for Amps measuring have distance limitations (mVolt output)
- DC Voltage cabling will be at system bus voltage 600V/1000v/1500V etc.
- Knowledge of RS485 and TCP/IP necessary to work with meters
- Manufacturers are few:
  - Accuenergy
  - Measurelogic
  - Sensus

- Manufacturers need to integrate functionality into a single device and eliminate gateway(s).
- Manufacturers need to upgrade to Utility Grade housings/terminals etc.

Questions?

Tom Fenimore, PE
704-608-2389
tom.fenimore@duke-energy.com

Presson Exhibit No. 9
Docket No. E-2, Sub 1293

PRESSON CONFIDENTIAL EXHIBIT NOS. 10 - 13

DOCKET NO. E-2, SUB 1293

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Statement of Work

This **STATEMENT OF WORK (SOW or Statement of Work)** No. 32 is made effective as of December 1, 2021 (the "**SOW Effective Date**") and is issued pursuant to the Master Research Agreement, effective August 1, 2011, between **THE UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE ("UNCC") and DUKE ENERGY BUSINESS SERVICES LLC ("Duke Energy").** The specific terms which will apply to this request are described below:

I. SERVICES DESCRIPTION AND OBJECTIVES:

Project Title: Power Flow Analysis to Improve Integrated Volt/Var Control (IVVC) and Energy Efficiency Programs

Integrated Volt/Var Control (IVVC) and other energy efficiency and optimization programs rely on power flow results to assure that the control actions are appropriate; therefore, accurate power flow results are critical to operate a distribution system safely and efficiently. Unfortunately, power flow results are not always accurate, and existing methods of analysis provide very limited information about the cause of the inaccuracy. Moreover, with the current Distribution Management System (DMS) it has been observed that the performance of the power flow deteriorates considerably when there are Distributed Energy Resources (DER) on a distribution system. This project will address these issues by using data analytics to parse through data and identify factors that are most relevant to the quality of a power flow solution. The analysis will inform and guide modeling changes to be made to improve power flow performance. This research will directly benefit IVVC programs and enable utilities to operate IVVC more effectively on systems with high levels of DERs.

The proposed project is based on and extends upon preliminary results obtained in a comparative analysis between the DMS and other power flow tools performed in CAPER projects PU-01 and EHP-08-PU. In those projects, differences in the modeling and in the power flow performance between the software tools were identified, and important criteria for power flow performance were identified by parsing through an initial dataset of select DMS savecases. This project will have the following main aspects and objectives:

1. Preliminary observations made in the initial dataset will be tested on a larger and more varied dataset and using outputs obtained with the new version of the DMS software. Voltage mismatch will be included as a criterion for power flow performance. Based on the results of the analysis, the research team will develop recommendations of modeling changes to be made to improve power flow performance. The recommended changes will be implemented, and the obtained updated results will be analyzed.
2. A detailed analysis of the results obtained from feeders that are not consistent in their power flow performance (i.e. the 'flip-flop' cases) will be carried out. The most important characteristics that separate the converging and non-converging savecases will be

identified and will inform recommendations of modeling changes. The recommended changes will be implemented, and the updated results will be further analyzed.

3. Both parts of the project (1 and 2 above) will use results obtained with the new version of the DMS software, which includes a model for DERs. The research team will analyze and compare results to check whether the inclusion of the DER model improves power flow solutions and will look for aspects of the DER model (and the DMS model as a whole) that could be modified to improve power flow performance.

II. DELIVERABLES:

A report describing methods and findings from each of the three aspects of the project will be submitted as project deliverable. Specifically, the report will include:

- The methods developed for assessing the performance of the DMS power flow tool;
- New models and methods that will improve the performance of the DMS power flow tool;
- Observations and recommendations made specifically for feeders with high DER penetration.

The developed data analytics tool, or the requirements and configuration steps to develop it, will be provided as well.

III. MAJOR ACTIVITIES AND TIMELINE:

Start Date: 12/20/2021 **Completion date**: 6/20/2023

Project Phase 1 (1/1/2022 – 12/31/2022): Parameters identified in the analysis of the initial dataset (CAPER projects PU-01 and EHP-08-PU) will be tested on a larger and more varied dataset provided by Duke Energy, and with the use of the new version of the DMS software. Recommendations to improve DMS power flow performance will be made based on the results of the analysis. Observations and recommendations made specifically for feeders with DERs will be highlighted. The recommended changes will be implemented, and the obtained updated results will be analyzed.

Project Phase 2 (8/1/2022 – 6/30/2023): A detailed analysis of the results obtained from feeders that are not consistent in their power flow performance will be carried out. The most important characteristics that separate the converging and the non-converging savecases will be identified and will inform recommendations of modeling changes. The recommended changes will be implemented, and the updated results will be further analyzed.

IV. ACCEPTANCE PROCEDURE:

AS DEFINED IN THE MASTER RESEARCH AGREEMENT

V. INFORMATION/FACILITIES/RESPONSIBILITIES TO BE FURNSIHED BY DUKE ENERGY: Duke Energy shall provide UNCC access to information and data relevant to the activities described above and as mutually agreed by Duke Energy and UNCC. Any and all data shared belongs to Duke Energy, and shall be used by UNCC solely for the purpose of UNCC's obligations under the SOW.

VI. OTHER REQUIREMENTS/PRE-EXISTING WORKS /OR SPECIAL CONDITIONS (if applicable):

Publication of any findings from the research shall be subject to confidentiality and intellectual property restrictions and processes defined in the Masters Research Agreement.

The parties hereto explicitly agree that section 2.B of the Master Research Agreement conflicts with the following language and shall not be applicable to this Statement of Work and the compensation for the services specified herein will be made by Duke Energy in the sum of $215,000 (Two-Hundred-Fifteen-Thousand Dollars), i.e. this work shall be performed on a "fixed price" basis. Duke Energy agrees to pay the sum of $215,000 upon a fully executed agreement.

Invoices should be directly submitted to: supplierservices@duke-energy.com

Duke Energy agrees to pay said invoices within 45 days of the invoice date. University reserves the right to discontinue work if Duke Energy fails to pay invoices within the time herein specified.

VII. FEES AND EXPENSES:

The total budget for personnel and University fees is $215,000. Both parties agree to cover their own expenses for work related to this project <u>other than stated above</u>. Each party will endeavor to obtain concurrence if a project decision will require a significant expense from the other party.

VIII. IP OWNERSHIP: Intellectual property restrictions, rights and processes will be as per defined in the Master Research Agreement.

IX. PRINCIPAL REPRESENTATIVES

THE PARTIES ACKNOWLEDGE THAT THEY HAVE READ THE STATEMENT OF WORK NO. 32, UNDERSTAND IT, AND AGREE TO BE BOUND BY ITS TERMS AND CONDITIONS. FURTHER, THE PARTIES AGREE THAT THE COMPLETE AND EXCLUSIVE STATEMENT OF THE AGREEMENT BETWEEN THE PARTIES RELATING TO THIS SUBJECT SHALL CONSIST OF 1) THIS STATEMENT OF WORK NO. 32, 2) ITS SCHEDULES, AND 3) THE MASTER RESEARCH AGREEMENT (INCLUDING THE EXHIBITS THRERETO), INCLUDING THOSE AMENDMENTS MADE EFFECTIVE BY THE PARTIES IN THE FUTURE. THIS STATEMENT OF THE AGREEMENT BETWEEN THE PARTIES SUPERSEDES ALL PROPOSALS OR OTHER PRIOR AGREEMENTS, ORAL OR WRITTEN, AND ALL OTHER COMMUNICATIONS BETWEEN THE PARTIES RELATING TO THE SUBJECT DESCRIBED HEREIN.

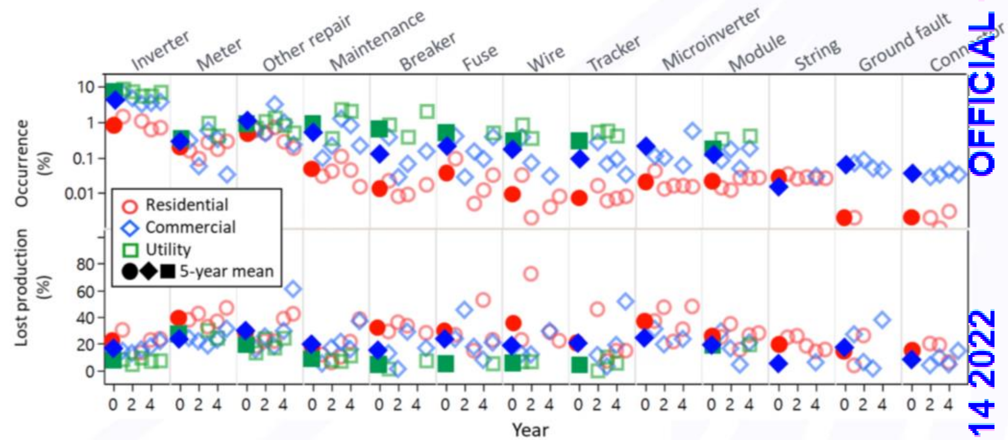
"DUKE ENERGY" Duke Energy Business Services, LLC	**"UNCC"** University of North Carolina at Charlotte
By: Jonathan M. Jones	By: DocuSigned by: Hector Henry III 48BBCF7785DF4CC...
Print: Jonathan M. Jones	Print: Hector Henry III
Title: Lead Sourcing Specialist	Title: Senior Contracting Negotiator
Date: December 8, 2021	Date: 12/09/2021 | 7:46 AM EST

Reliability Assessment for Utility PV Inverter System

Dr. Tiefu Zhao, University of North Carolina at Charlotte, Tiefu.Zhao@uncc.edu

Background/Trend

- Reliability is critical for PV systems to maintain safety, efficiency, and uptime.
- DOE SETO office's current focus: "improving reliability and efficiency of new and existing PV technology" – with the goal of **increasing PV useful system life to 50 years** while lowering the cost of energy.
- **PV inverters** are associated with **40% or more of the service requests** – single largest category.



PV system hardware failures (data based from100k+ systems in the U.S.)
Source: Dirk Jordan, PV System Failures – temperatures & installation effects, IEEE PVSC 2020.

Objectives

- Develop a **reliability assessment** tool to support the development of safer and more reliable PV.
- **Quantitively assess** the PV system **reliability** based on the field data provided by Duke Energy.
- **Provide recommendations** for failure mechanism identification, **predictive maintenance** and **lifetime extension strategy.**

Near Miss Arc Flash – Twin Rivers Solar Project (source: ***Duke Energy Safety Alert,*** *April 2021)*

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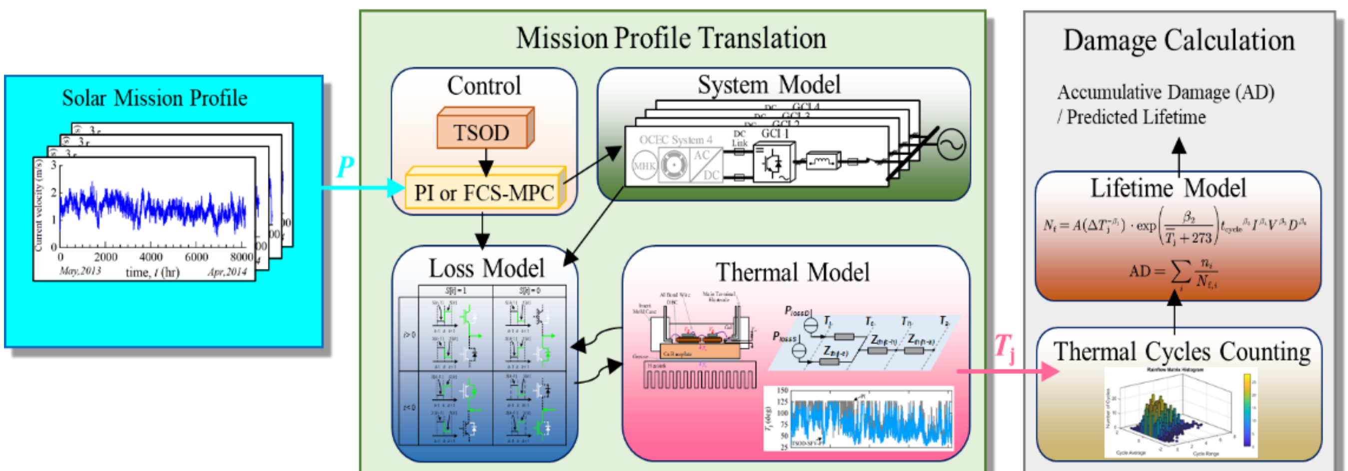
Reliability Assessment for Utility PV Inverter System

Dr. Tiefu Zhao, University of North Carolina at Charlotte, Tiefu.Zhao@uncc.edu

Technical Approach

- Investigate integrated reliability for **critical Balance of Systems (BOS) components** in utility PV system, including PV inverters, PV protection devices, ground and arc fault detection.
- Develop PV inverter thermal stress and **remaining useful lifetime (RUL) estimation**, and reliability oriented thermal management.
- Provide **predictive maintenance recommendations** based on the analysis of field data (including irradiance, temperature, PV system layout and inverter control).
- Conduct **NFPA standard review** on PV fire and arc flash protection.
- Recommend **lifetime extension strategies** based on a case study of the PV system at Duke's choice.



Reliability assessment framework for utility PV system

UNIVERSITY OF NORTH CAROLINA CHARLOTTE

Reliability Assessment for Utility PV Inverter System

Dr. Tiefu Zhao, University of North Carolina at Charlotte, Tiefu.Zhao@uncc.edu

PV Data Needed

The team plans to work closely with Duke Energy to collect **available data from existing PV system** for reliability assessment. Data that can be used in this project include:

- Solar mission profile (output/input power record)
- Environment data (irradiance, temperature, humidity)
- PV inverter data (manufacturer part number and control), PV system single line diagram, layout, and grounding, etc.
- O&M record and equipment fault log (if available)
- Grid disturbance (optional)

Funding Request

- $100K for 1 Year

Project Milestones and Timeline:

- Define and collect available data for PV system reliability assessment – M1
- Investigate integrated reliability for critical BOS components through data analysis, lifetime and failure mechanism characterization – M3
- Develop PV inverter thermal stress and remaining useful lifetime (RUL) estimation – M6
- Modeling and simulation of PV inverter with the reliability oriented thermal management (including thermal and lifetime model) – M9
- Model validation and performance assessment based on field data – M11
- Provide recommendations for predictive maintenance and lifetime extension strategy – M12

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