

Phase Two Activity
Washburn and Bayfield Solar Photovoltaic
Financial and Energy Analysis
Data and Assumptions

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Disclaimer

The information presented here provides a feasibility study level overview of solar PV projects siting, sizing, generation, site electricity use offset, pricing and project economics. It should not be used as the only source of information.

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Ownership Option Definitions

Direct Ownership

The local unit of government pays the full cost of the PV system and owns, operates, maintains and insures the PV system. The project's State and Federal tax benefits are not monetized.

Co-owned with Third Party Participant (TPP)

The TPPs are outside investors that own, operate, maintain and insure the solar PV system. They receive the project's tax benefits and energy service payments from the local government through the term of the Energy Services Agreement. The TPP sells the system to the local government any time between then end of year 7 and 25.

- The government body is the "Applicant" for purposes of the Wisconsin Public Service Commission's Distributed Generation Application Form and the local electric utility
- The project is largely owned by an LLC entity created solely for this project and in order to monetize some of the tax benefits
- The government body's co-ownership is often paid by the Focus on Energy grant and/or other grant
- The government body's co-ownership is between 10% and 25% of PV system.
- The government body is a party to a co-ownership agreement with the LLC entity and is a member of the board that manages the operation of the project
- The LLC Entity enters in to a services agreement with the government body that may provide: a. building energy management services to increase the energy efficiency of government buildings; b. solar energy system services for design, installation, operation, and for delivery of solar energy; and, c. informational services, including back ground information and data kiosk support.
- The services agreement incorporates a fixed monthly service fee (annual fee adjustments, in some cases, may apply)
- At the end of the contract term, the government body may either purchase the solar PV system or ask it to be removed by the TPP (at the TPP's cost)
- The government body is not required to purchase the PV array
- The government body's purchase cost must be greater or equal to the residual value of the PV system (requirement of the IRS).

- It is recommend that the government body entering a contract with a TPP has legal representation

Risk

Risk Matrix – who carries the risk

	PV System Owned by Local Government	PV System Co-owned with TPP
Installation Risk	Local Government	TPP
Technology Risk	Local Government	TPP Local Government after taking ownership
Solar Resource/Power Production Risk	Local Government	TPP ¹ Local Government for large acts of nature ²
O&M Risk	Local Government y	TPP Local Government after taking ownership
Natural Disaster Risk	Covered by insurance	Covered by insurance

Financial Definitions

Internal Rate of Return (IRR)

- Definition 1: The actual return provided by the project's cash flows
- Definition 2: The interest rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equal zero
- Can be used to compare other investment returns

Discounted Net Present Value (NPV)

- The difference between the discounted value of cash inflows and the discounted value of cash outflows
- Discounting uses the discount rate, the discount rate is

¹ For normal variations of the solar resource

² For example major volcanic events or geo-engineering/cloud seeding

- The percentage that each future year's cash inflows and outflow are reduced to reflect the time value of money

Analysis Data and Assumptions

Xcel Electric Rates

CG-7 General TOD Service-Sec, secondary voltage rate

- See Annex 2

Usage (kWh) charges

Rate	Off peak electricity use (\$ per kWh)	Business day electricity use 9 am to 9 pm (\$ per kWh)	
		Summer	Winter
CG 7	\$0.05602	\$0.07521	\$0.07021

Demand (kW) Charges

	\$ /month kW	
Annual	\$0.5	
	Summer \$/kW	Winter \$/kW
Monthly	13.00	11.00

CG-2 Small General Service rate

- See Annex 3

Rate	All electricity (\$ per kWh)	
	Summer	Winter
CG 1	\$0.12518	\$0.11365

Parallel Generation (net metering) rate PG-1

- See Annex 4
- Net metering for PV systems of 100 kW ac and under
- No customer charge or other fees

PV System Components

Used in Helioscope modeling

- Modules: Canadian Solar CS6U 345M (345 watts)
- Inverters
 - 120.1 kW array, four SMA STP 25000 30 (25 kW ac)
 - 108.7 kW array at the Washburn Jail, nine SMA Sunny Boy SB 10000TLUS -10
 - 77.3 kW at the Old National Park Head quarters, three SMA Sunny TriPower 24000TL-US
 - 55.9 kW array at the Housing Authority, Lake View Apartments, two SMA TriPower 24000TL-US
 - 40.3 kW array at the Washburn Garage, two SMA Sunny Tripower 24000TL-US
 - 38.6 kW at the Pavilion, three SMA STP 15000TL-US
 - 27.9 kW array at the Bayfield City Hall garage, one SMA TriPower 24000TL-US

Solar Resource Data

(Used in Helioscope modeling)

- Ironwood, Michigan TMY3 data
- Located 38 miles from Bayfield and 37 miles from Washburn

Array Soiling and Snow Cover Losses

Month	10° Tilt Ballasted flat roof	12.5° Tilt Curved metal roof 17° tilt shingle roof	30° Tilt Ground mounted	45° Tilt Ground mounted	Helioscope Standard Assumption
January	65%	60%	50%	15%	2%
February	65%	60%	30%	15%	2%
March	25%	10%	5%	5%	2%
April to October	1%	1%	1%	1%	2%
November	10%	10%	5%	5%	2%
December	50%	40%	30%	10%	2%

1% summer, fall and spring losses due to regular washing by rain

System Cost

- Systems of over 50 kW – bid out as group

- Assumes roughly 400 kW installed across four sites
- Based on recent bids (Fall/Winter 2017 and 2018)
- Ground mounted: \$1.70/watt
- Roof ballasted racking mounted: \$1.70/watt
 - Some bidders have same pricing for flat roofed and ground mounted arrays
- Systems of under 50 kW- bid out as a group
 - Assumes roughly 200 kW installed at 4 – 6 sites
 - Ground mounted: \$1.85/watt
 - Roof ballasted racking mounted: \$1.85/watt
- Pricing does not include
 - Extended warranty for inverters
 - Unusual Xcel interconnection costs
 - Local government costs including staff, consultants, legal review, etc.
 - Large unforeseen site expenses (e.g., electrical panel/system upgrade, roof structural issues, etc.)

Re-roofing costs

- \$400/kW Cost for moving a flat-roof ballasted array, to reroof, and then reinstall the array. Assumes PV array components stays on the roof and are not moved to the ground.
 - Estimate based on estimates from PV system installers
- For sites with aged roofing assume this occurs in year 10

Value of Solar Generation: CG-7 and PG-1 rates

Estimated using hourly PV Watts data for Iron Wood MI and the CG-7 tariff schedule

Electricity usage (kWh) value:

- Array facing due south 10° tilt: 6.723 cents/kWh
- Array facing due south 30° tilt: 6.720 cents/kWh

Electricity demand (kW) Value

Weighted average monthly (based on expected generation): \$ 11.95/kW

Annual demand savings: \$0.50/kW

Value of Demand Savings

- Monthly: 12.5% of the kW dc rating of the PV system

- Annual: 7.5% of the kW dc rating of the PV system

Value of Solar Generation: CG-2 and PG-1 rates

All kWhs:

- Summer: 12.518 cents/kWh
- Winter: 11.365 cents/kWh

No demand charges

kWh Value, bases on expected annual generation

- 11.9 cents/kWh

General Modeling Assumptions

- System output degradation: 0.5%/year
- General inflation: 3%/year
- Energy cost inflation: 3%/year
- Discount rate for the local unit of government: 3%
 - Used only in NPV calculation
- Pounds CO₂ emitted per kWh of conventional power generated: 881 pounds/kWh (Source: Xcel 2016 Corporate Responsibility report)

Modeling Assumptions: Municipality Ownership

Annual Costs

- Insurance: 0.35% of system cost
- Operation and Maintenance: 0.25% of system cost
- Replacements: 0.1% of system cost

Inverter replacement costs

- Year 20, 0.5% of system cost
- Year 25, 0.25% of system cost

Loan/financing/bonds

- Interest rate: 4%
- Term: 20 years
- Share of project cost: 85%

Modeling Assumptions: Co-owned with Third Party Participant (TPP)

TPP Costs included in the initial project cost:

- Permits, fees, contingency: \$300/site
- Property insurance: 0.2% of system's installed cost

- Legal total: \$2,500/site
- Accounting: \$500 each site
- Upfront general liability: 0.15% of system's cost
- Loan fees: \$300 each site
- WI DFI fee: \$200 each site
- Construction loan interest: 0.6% of loan amount
- Development fee: 7% of initial investment (all costs less Focus on Energy grant)

Tax prep. Years 1 and 2: \$1,500/year each

Tax prep. Years 3 to ownership change: \$633/year each

Operation and Maintenance and Replacements: 0.35% of system cost

Insurance (property and general liability): 0.35% of system cost

Tax Benefits

- Investment tax credit (ITC): 30%
- Standard MACRS depreciation over 5.5 years
 - Individual passive investors are unable to depreciate the project in year 1 (with tax law allows Corporations to do this)
- State tax rate: 5%
- Federal tax rate: 27%

TPP Contract and Economics

- Energy Service agreement increase: 3%/year
- Site owner buy out: year 12
 - At 30% of system cost (or fair market value (FMV))
 - Analysis assumes 30% of system cost
- Investor return 13%
- Debt to Service Coverage Ratio (DSCR): 1.3
- Loan interest rate: 5.6%
- Loan term: 12 years

Discussion of Key Assumptions

- Pricing: \$1.70/kW dc
 - Late February 2018 bid for three PV systems totaling 240 kW system was \$1.78/watt
- Electricity price escalation rate: 3%
 - 3% for kWh and kW is reasonable, mostly with increasing inflation
 - Used it at Sauk County
- Monthly demand savings: 12.5% of the kW dc rating of the PV system
 - At a Madison-area school with PV and air conditioning, this is between 15% and 20%
- TPP investor's state tax rate, used in valuing depreciation benefits: 5%
 - Depends on home to TPP investors. For example the IL state tax rate is 4.9%
 - Wisconsin tax rate for higher income individuals is 6.3% to 7.6%
- TPP investor's federal tax rate, used in valuing depreciation benefits: 27%
 - 30% before the recent federal tax changes

Annex 1, Site Ownership

Site	Site Owner	System Size kW dc
Washburn High School	Washburn School District	120
Washburn Elementary		120
Housing Authority Lakeview	50% City of Washburn 50% County of Bayfield	56
Washburn WWTP	City of Washburn	120
County Jail	County of Bayfield	109
County Garage		40
Totals	Washburn School District	240
	City of Washburn	148
	County of Bayfield	177 (137 ³)

Bayfield School District, City of Bayfield and Pike's Sanitary District Site Ownership

Site	Site Owner	System Size kW dc
Bayfield Rec Center	Bayfield School District owns, operated by nonprofit	42
Bayfield School		120
Bayfield City Hall	City of Bayfield	27
Bayfield Pavilion and Docks 1 & 2	City of Bayfield	39
Bayfield Old Court House	City of Bayfield	87
Bayfield WWTP	50% City of Bayfield, 50% Pikes Sanitary District	120
Totals	Bayfield School District	162 (120)
	City of Bayfield	213 (147)
	Pikes Sanitary District	60

³ Systems larger than 50 kW

As mapped out above the TPP would require 6 sets of contracts

- Washburn School District
- City of Washburn
- County of Bayfield
- Bayfield School District
- City of Bayfield
- Pikes Sanitation District

Complexities at the Washburn Lakeview Apartment may require an additional contract.

Annex 2, XCEL Cg-7 General Service TOD Rate Sheet

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WISCONSIN**

REVISION: 5

SHEET NO. E 25.2

SCHEDULE Cg-7

WISCONSIN ELECTRIC RATE BOOK

VOLUME NO. 7

AMENDMENT NO. 750

GENERAL TIME-OF-DAY SERVICE

Availability: Available to any non-residential customer for single- or three-phase electric service supplied through one meter where customer's demands are measured and where customer is not required to be on the Large General Time-of-Day service, Schedule Cg-9. This service is mandatory for customers that meet the above criteria and Time-of-Day metering is available. Other customers may select this service on an optional basis, if Time-of-Day metering is available.

Any customer that chooses this rate schedule as an option to other available rate schedules waives all rights to any billing adjustments arising from a claim that the bill for the customer's service would be less on any alternative rate schedule for any period of time.

Kind of Service: Alternating current at the following nominal voltages:

- (a) Secondary Voltage Service— three-wire single-phase and three- or four-wire three-phase at 208 volts or higher;
- (b) for Primary Voltage Service— three-phase at 2400 volts or higher.

Service voltage available in any given case is dependent upon voltage and capacity of existing Company lines in vicinity of customer's premises.

Rate:

<u>Customer Charge per Month</u>		\$ 42.00		
<u>Demand Charges per Month per kW</u>				
On-peak Demand		<u>Secondary Voltage</u>	<u>Primary Voltage</u>	
June—September		\$ 13.00	\$ 12.35	R
October—May		\$ 11.00	\$ 10.45	R
Distribution Demand		\$ 0.50	\$ 0.30	N
<u>Energy Charge per kWh</u>		<u>June to September</u>	<u>October to May</u>	
On-Peak	Secondary	7.521 ¢	7.021 ¢	R
Off-Peak	Secondary	5.602 ¢	5.602 ¢	R
Energy Charge Discount (before Energy Cost Adjustment and Energy Charge Credit)				
Primary			2.0 %	
<u>Energy Charge Credit per Month</u>				
All kWh in Excess of 400 Hours		1.50 ¢		R
times the On-Peak Billing Demand				

Energy Cost Adjustment: Bills subject to the adjustment provided for in Energy Cost Adjustment. See schedule X-1, Sheet No. E 63.

Non-Demand Billing Option: Customers with a measured 15-minute demand of less than 25 kW for twelve consecutive months will have the option of transferring to either the Small General Service (Schedule Cg-2) or the Small General Time of Day Service (Schedule Cg-1).

(continued)

ISSUED: December 26, 2017.

EFFECTIVE: For service rendered on and after January 1, 2018.

PSCW AUTHORIZATION: Order in Docket No. 4220-UR-123 dated December 21, 2017.



GENERAL TIME-OF-DAY SERVICE (continued)

Billing Demand Limit: In no month will the on-peak billing demand be greater than the value in kW determined by dividing the kWh sales for the billing month by 100 hours.

Definition of Peak Periods: Unless specified to the contrary in writing by the Company to any customers using this schedule and refile this rate sheet not later than November 1 of each year, on-peak hours shall be from 9:00 a.m. to 9:00 p.m. Monday through Friday, inclusive (excluding holidays), for the twelve months beginning with the first full billing period following December 15. The holidays designated shall be New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas, on the day nationally designated to be celebrated as such. When a designated holiday occurs on Saturday, the preceding Friday will be considered an off-peak day. When a designated holiday occurs on Sunday, the following Monday will be considered an off-peak day.

Off-peak hours are times not specified as on-peak hours.

Determination of On-Peak Billing Demand: The On-Peak Billing Demand in kilowatts will be the greatest Current Month On-Peak Period Demand, rounded to the nearest whole kW. The On-Peak Billing Demand will be adjusted for power factor, when customer's measured demand is greater than 100 kW for four of twelve months. When customer's measured demand remains below 100 kW for twelve consecutive months Power factor adjustment is discontinued.

Current Month On-Peak Period Demand: The Current Month On-peak Period Demand shall be the greatest 15-minute load, adjusted for power factor, which occurs during any on-peak hours. The Company, at its sole discretion, has the option of adjusting Current Month On-peak Period Demand if the Power Factor Adjustment provides a significant and unintended bill increase for a customer new to this service.

Power Factor Adjustment for On-Peak Period Demand: When the average on-peak power factor is less than 90%, the On-Peak Billing Demand shall be determined by multiplying the greatest 15-minute load during the on-peak period by 90% and dividing the product thus obtained by the Average On-Peak Power Factor expressed in percent.

Distribution Billing Demand: The distribution billing demand shall be the customer's greatest 15 minute load, regardless of time-of-day and not adjusted for power factor, which occurred during the past 12 months, including the current month. In no month will the distribution demand be greater than the value in kW determined by dividing the kWh sales for the billing month by 100 hours.

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Average On-Peak Power Factor: The Average On-Peak Power Factor is defined to be the quotient obtained by dividing the on-peak kilowatt-hours used during the month by the square root of the sum of the squares of the on-peak kilowatt-hours used and the lagging reactive kilovolt-ampere-hours supplied during the same on-peak period. Any leading kilovolt-ampere-hours supplied during the on-peak period will not be considered in determining the Average On-Peak Power Factor.

(continued)

ISSUED: December 26, 2017.

EFFECTIVE: For service rendered on and after January 1, 2018.

PSCW AUTHORIZATION: Order in Docket No. 4220-UR-123 dated December 21, 2017.

GENERAL TIME-OF-DAY SERVICE (continued)

Commercial Load Control Rider: A monthly credit is available, on an optional basis, for company control of all or part of customer's load during company's interruption periods.
(See Rate Sheet No. E24.50)

Monthly Minimum Charge: The customer charge.

Term of Agreement: One year or longer as provided in General Rules and Regulations.

Late Payment Charge: A one percent (1%) per month late payment charge will be applied to outstanding charges unpaid 20 days after the date of billing.

Rate Code:

B15 General Time of Day Service

ISSUED: December 27, 2012

EFFECTIVE: For service rendered on and after January 1, 2013.

PSCW AUTHORIZATION: Order in Docket No. 4220-UR-118 dated December 27, 2012.

Annex 3, XCEL Cg-2 Small General Service Rate Sheet

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SCHEDULE Cg-2

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VOLUME NO. 7

AMENDMENT NO. 750

SMALL GENERAL SERVICE

Availability Available to non-residential customers for single- or three- phase electric service. Not available for customers with a Maximum Demand of 25 kW or greater.

Rate:

Customer Charge per Month (metered)

Single Phase	\$ 17.00	R
Three Phase	\$ 20.50	R

Customer Charge per Month (unmetered)

Single Phase	\$ 4.50
Three Phase	\$ 6.50

<u>Delivery Charge per kWh</u>	4.200 ¢	N
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Energy Charge per kWh

June—September	8.318 ¢	R
October—May	7.165 ¢	R

<u>Water Heating Meter Charge per Month per Meter</u>	\$ 2.50
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Energy Cost Adjustment: Bills subject to the adjustment provided for in Energy Cost Adjustment. See Schedule X-1, Sheet No. E 63.

Monthly Minimum Charge The total of the customer charge and any applicable meter charges.

Terms and Conditions

1. To measure demands, the Company will install a Time-of-Day demand meter for customer when:
 - A. Customer's connected load is estimated to be 20 kW or greater, or
 - B. Customer is serviced single-phase and has a service entrance capacity greater than 200 amperes, or
 - C. Customer is served three-phase at 120/208 or 120/240 volts and has a service entrance capacity greater than 200 amperes, or
 - D. Customer is served three-phase at 240/480 or 277/480 volts and has service entrance capacity greater than 100 amperes, or
 - E. Customer's average monthly kWh use for four consecutive months exceeds 3,500 kWh.

A customer's Maximum Demand is the greatest 15-minute load, regardless of time-of-day. If a demand meter is installed in accordance with the above, then the customer may remain on the Small General Service Schedule as long as customer's Maximum Demand is less than 25 kW. Company will notify customer of any failure to comply with this Maximum Demand requirement. Any customer that has a Maximum Demand of 25 kW or greater for at least four out of twelve consecutive months or a Maximum Demand of 50 kW or greater during any month, will be placed on the General Time-of-Day Service Schedule Cg-7, in the next billing month. Customers with a Maximum Demand of less than 25 kW for twelve consecutive months may return to the Small General Service schedule.

(continued)

ISSUED: December 26, 2017.

EFFECTIVE: For service rendered on and after January 1, 2018.

PSCW AUTHORIZATION: Order in Docket No. 4220-UR-123 dated December 21, 2017.

SMALL GENERAL SERVICE (continued)

Terms and Conditions (Continued)

2. Any customer that chooses this rate schedule as an option to other available rate schedules waives all rights to any billing adjustments arising from a claim that the bill for the customer's service would be less on any alternative rate schedule for any period of time.
3. Customers served on the Athletic Field Lighting Rider as of December 31, 1987 will be billed on the Small General Service schedule.

Commercial Load Control Rider: A monthly credit is available on an optional basis for company control of all or part of customer's load during company's interruption periods. R
(see Rate Sheet No. E24.50)

Term of Agreement: One year or longer as provided in the General Rules and Regulations.

Late Payment Charge: A one percent (1%) per month late payment charge will be applied to outstanding charges unpaid 20 days after the date of billing.

Rate Codes:

- B06 Small General Service
- B07 General Water Heating Service – Commercial (Closed) – [No Customer Charge]
- B09 Small General Service – Unmetered
- B37 Controlled Water Heating Service – Commercial (Closed) – [Includes Extra Meter Charge, No Customer Charge]

ISSUED: December 23, 2009

EFFECTIVE: For service rendered on and after January 1, 2010.

PSCW AUTHORIZATION: Order in Docket No. 4220-UR-116 dated December 22, 2009

Annex 4, Xcel Pg-1 Net Metering Rate Sheet

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SCHEDULE Pg-1

WISCONSIN ELECTRIC RATE BOOK

VOLUME NO. 7

AMENDMENT NO. 750

PARALLEL GENERATION - NET ENERGY BILLING SERVICE

Effective In All territories served by the Company.

Availability Available to any retail electric customer with customer owned renewable resource generation of 100 kW or less per site for purpose of operating generation interconnected with Company's system, where customer's delivery offsets retail electric consumption at the same site. If a customer has more than one electric generator on a site, the generators' ratings shall be summed and the sum may not exceed 100 kW per site. For purposes of determining compliance with this paragraph, generator size shall be determined based on the alternating current (AC) nameplate rating of the generator or inverter, as applicable.

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Renewable resource generators include generating systems which exclusively utilize wind, solar photovoltaic, wood or wood waste, refuse derived fuel, biogas, or hydro-electric generators that must meet the renewable resource definition contained in Wisconsin Statute 196.378. Renewable resource generation equipment must be located on the customer's premises serving only the customer's premises.

Monthly Energy Credit

- 1) A retail electric customer generating power with renewable resource facilities shall be billed monthly on a net energy basis. The retail electric customer may offset electricity usage measured on a single retail electric meter located at the same site each month on a net energy basis. For customers served under a Time of Use metered service, on-peak period generation shall only offset customer's on-peak period consumption. Off-peak period generation shall only offset customer's off-peak period consumption. For customers served under a non-Time of Use metered service, all generation shall offset customer's consumption, regardless of Time of Use.
- 2) Generation produced by Customer's facility and delivered to the Company in excess of Customer usage will be carried forward from month-to-month until the end of the calendar year in which the excess generation is produced. Customer usage in any given month will be netted against the outstanding generation balance(s).
- 3) At the end of the calendar year any excess generation will be netted against any usage not already offset during the calendar year. Customer will receive a credit for generation that is netted against any usage not already offset during the calendar year at the customer's retail rate. If customer receives retail service on a Time of Use basis, then customer will receive credit for any remaining generation balance after this netting at the appropriate (either on-peak or off-peak) Pg-2A service rate. If customer receives retail service on a non-Time of Use basis, then excess generation at the end of the calendar year, shall be compensated at the Pg-2A service using the weighted average of 34.8% of the on-peak Pg-2A rate and 65.2% of the off-peak Pg-2A rate.
- 4) This credit will be issued to the customer in the form of a check. Any credit balance \$2.00 or less in value will be applied to the customer's account.

(continued)

ISSUED: December 26, 2017

EFFECTIVE: For service rendered on and after January 1, 2018.

PSCW AUTHORIZATION: Order in Docket No. 4220-UR-123 dated December 21, 2017.



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SCHEDULE Pg-1.1

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AMENDMENT NO. 743

PARALLEL GENERATION - NET ENERGY BILLING SERVICE (cont'd)

Special Rules

- 1) Customer's generation facility shall be permanently connected to only those facilities receiving service under schedules with similar rate designs. Customer shall not switch the generation between two or more rate schedules. This tariff applies only to the energy generated by Customer's renewable resource generation facilities.
- 2) Customer shall retain all renewable credits and other attributes associated with the energy provided to the Company pursuant to this tariff.

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Energy Cost Adjustment Energy Payments based on retail energy rates are subject to the adjustment provided for in Energy Cost Adjustment. See Schedule X-1, Sheet No. E 63.

Late Payment Charge A one percent (1%) per month late payment charge will be applied to outstanding charges unpaid 20 days after the date of billing.

Terms and Conditions of Service See Schedule PG-3.