

**Otter Tail Power Company's  
Marginal Cost of Electric Service Study**

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## **I. INTRODUCTION**

Otter Tail Power Company (OTP) retained Economists Incorporated to prepare an update of the 2017 company's system-wide marginal cost of electricity service (MCOS) study for the time frame 2018 through 2022. This report summarizes the approach that we used for updating marginal generation, transmission, distribution, facilities costs and customer-related costs, and presents the results.

Economic theory holds that economic efficiency is maximized when customers respond to prices that reflect marginal costs. Marginal cost is defined as the change in total cost of service with respect to a small change in the demand of a product or service at any given time. In an electricity ratemaking process, estimates of marginal generation, transmission and distribution costs may be used as a guide to determine revenue requirement allocations by class, decide on the appropriate rate components, and the level of time differentiation by costing period and seasons.

Any electricity marginal cost analysis requires identifying the utility's wholesale energy and capacity market rules in the region where the utility operates, the system planning process, planned growth-related investment at the various levels of service, expected impact of load growth on utility system operations or contracting decisions, and customer-related costs.

## **II. TIME-DIFFERENTIATION OF MARGINAL COSTS**

The MCOS calculates hourly marginal energy and capacity costs, which are then aggregated by time of use periods to be useful for rate design and other purposes. The costing periods used in this MCOS study are based in OTP's periods and seasons as shown in Table 1.

**Table 1. Time of Day and Seasonal Periods**

<p><b>Summer: June – September</b></p> <p>Peak: Monday - Friday, 1 pm - 7 pm</p> <p>Shoulder: Monday - Friday, 11 am - 1 pm and 7 pm - 10 pm; Weekends, 11 am – 10 pm</p> <p>Off-Peak: Monday - Friday, 10 pm - 11 am; Weekends, 10 pm - 11 am</p> <p><b>Winter: October – May</b></p> <p>Peak: Monday - Friday, 7 am - 11 am</p> <p>Shoulder: Monday - Friday, 6 am - 7 am, 11am- 10 pm; Weekends, 6 pm - 10 pm</p> <p>Off-Peak: Monday - Friday, 10 pm - 6 am; Weekends, 10 pm - 6 pm</p>
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The resulting time-differentiated marginal costs were averaged for years 2018 -2022 and are shown in section IX.

### III. MARGINAL GENERATION COSTS

As a member of the Midcontinent Independent System Operator (MISO)’s electricity wholesale market, OTP buys and sells on an hourly basis as needed to achieve the lowest cost of serving its retail customers. In a competitive electricity market, the utility’s marginal cost of generation associated with an increase in the utility’s native load is the market price of energy, as well as the market price of capacity if the change occurs at a time of system peak demand.

Estimating the hourly marginal generation capacity cost requires an estimate of annual capacity market prices in the MISO region, the target planning reserve margin, and cost allocation factors that are based on MISO reserve adequacy rules.

#### A. Marginal Energy Costs

An increment of native load in any hour requires OTP to purchase more energy at the prevailing market prices or sell less to the market if OTP is a net seller in that hour. To update OTP’s marginal energy costs, we relied on the latest forecast available of MISO’s forward monthly peak and off-peak prices measured at the OTP node for the period January 2018 through December 2022 as a starting point of the marginal energy costs. OTP provided forward market prices at the OTP node which relied on 24 months of historical hourly price differentials between the Indiana node and OTP node<sup>1</sup>. We shaped the monthly energy peak and off-peak forward

<sup>1</sup> MISO On-peak period for purposes of forward prices is Monday – Friday, hours ending 7-22. All other hours are off-peak. Intercontinental Exchange (ICE) provides forward prices for the Indiana node which is the main trading node in MISO.

price at the OTP node using historical monthly averages of day-ahead hourly market prices for the period May 1, 2014 to December 31, 2017.

To convert market prices to energy marginal costs at customers' meters, we adjusted for the financial cost of working capital required and marginal energy losses incurred from the OTP hub to customer meters. Hourly losses were estimated from information on variable losses at system peak load (from OTP's 2010 loss study) and year 2016 OTP's hourly control area loads. The resulting forecasts of market energy prices for 2018-2022 were averaged by the costing periods identified in Table 1.

## **B. Marginal Generation Capacity Costs**

OTP procures capacity through bilateral capacity contracts to meet its minimum planning reserve requirements as a member of MISO. OTP's annual marginal cost of capacity cost is triggered by an increment of native load at the time of MISO coincident system peak. While OTP native loads peak generally in the winter, MISO is predominantly a summer-peaking region, therefore it is the summer peak that currently drives OTP's generation capacity obligations. In the summer, OTP may be able to sell any excess capacity to other utilities in the region, and the reduced market capacity sales when an OTP customer increases load represents an opportunity cost to the utility. To estimate marginal generation capacity costs for the period 2018 through 2022, we relied on the most up to date forecast of regional annual MISO market prices for capacity as a proxy for expected prices for OTP's capacity contracts.<sup>2</sup>

As directed by Module E-1 of the MISO Tariff, MISO conducts a Loss of Load Expectation (LOLE) study that determines the required resources and Planning Reserve Margin (PRM) that would allow achieving the target LOLE level. MISO calculates a target PRM such that the LOLE for next planning year is 1 day in 10 years. MISO coordinates with stakeholders to determine the appropriate PRM from the point of view of installed capacity resources ("PRM<sub>ICAP</sub>"). It also estimates PRM on unforced capacity (PRM<sub>UCAP</sub>) taking into account the weighted average forced outage rate of all the regional resources.<sup>3</sup> Under the existing construct, the PRM<sub>UCAP</sub> is applied to the expected peak of each LSE coincident with the MISO peak.

OTP's marginal generation capacity cost in any hour on a planning basis is a function of: the forecast annual capacity price, which varies with the level of capacity surplus in the region, the required PRM, and the probability that each hour is MISO's system annual peak hour. We used the expected annual target PRMs-ICAP for the next five planning years. For the planning year

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<sup>2</sup> Forward prices were developed by Wood Mackenzie as of July 2017 and reflect the expected near-term capacity surplus situation.

<sup>3</sup> MISO determines the UCAP value annually for each generating unit and then credits them their specific UCAP value for the purpose of meeting resource adequacy requirements.

2018/2019, MISO target reserve margin over the region-wide coincident peak demand was 17.1%.<sup>4</sup>

To determine MISO capacity price hourly allocation we run a probability of peak analysis using MISO's regional hourly loads for a historical 3-year period (2015-2017). Upon calculating the probability of peak for each daytype and season, we estimated OTP's hourly marginal generation capacity costs, adjusted by marginal losses and working capital. These costs were then summarized by period.

#### **IV. MARGINAL TRANSMISSION COST**

OTP's transmission system consists of 345 kV, 230 kV, 115 kV, 69 kV and 41.6 kV facilities. Any transmission lines at above 100 kV are under the functional control and planning of MISO and included as part of the Network Upgrade Charge (NUC). OTP has operational control of its transmission facilities at or below 100 kV, which are included in the calculation of FERC-approved MISO Network Integration Transmission Service rate (NITS) for OTP's Control Area. OTP operates in a joint pricing zone within the Midwest ISO. In addition to OTP's revenue requirement, the NITS charge recovers the annual transmission revenue requirements for the Great River Energy (GRE) facilities located in the OTP Pricing Zone and for OTP transmission facilities.

The NUC rate generally recovers the costs of new transmission facilities above 100 kV. The cost of all new projects rated 345 kV and above with a project cost of \$5M or greater is allocated through a hybrid method, so that 20% of the costs are allocated on a system-wide basis and the remaining 80% are allocated to planning sub-regions (West, Central and East) and pricing zones under a method that differs between economic and reliability projects. For transmission projects rated below 345-kV, all costs get allocated on a zonal basis based on each transmission pricing zone's contribution to MISO's 12 CPs. Both the MISO NITS and NUC charges are constant every month, as they reflect 1/12 of the applicable annual revenue requirement per kW.

##### **A. Network Integration Transmission Service Rate**

The NITS rate is recovered from each transmission user in the OTP Pricing Zone based on their monthly coincident peak loads. From the point of view of OTP, an increase in monthly coincident peak triggers an increase in its MISO transmission bill. These charges represent a financial marginal cost to OTP. The starting point for the financial marginal transmission cost in MCOS was 2017 OTP's NITS rate.

Estimating the change in NITS charges beyond 2017 required identifying the projected annual increase in NITS revenue requirement associated with OTP's applicable new transmission

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<sup>4</sup> "Planning Year 2018-2019 Loss of Load Expectation Study Report". MISO LOLE Working Group.



projects, using OTP budgets for 115-kV (below \$5 million), 41.6 kV and 69 kV projects expected to come into service in the period 2018-2022, and excluding the projects that qualify for recovery through the transmission cost rider (TCR). MISO's estimates of annual carrying charge for OTP were applied to the budget figures to compute an annual incremental revenue requirement for the OTP Pricing Zone NITS. This amount was divided by the forecast of 12 monthly OTP's control area CPs to compute an annual per-kW NITS charge.

## **B. Network Upgrade Charge Rate**

To estimate the second component of the financial transmission marginal cost, the NUC rate, we relied on MISO's calculation of projected annual revenue requirement as per Schedule 26. The total NUC transmission revenue requirement allocated to the OTP Pricing Zone is the sum of a system-wide allocation, a sub-regional allocation, and the individual allocations corresponding to new projects. To estimate the NUC charges corresponding to the OTP Pricing Zone for the period 2018 through 2022, we divided MISO's NUC-related annual incremental transmission revenue requirements allocated to OTP's pricing zone by the expected 12 monthly coincident peak in each year used. The total dollar revenue requirement amount was then divided by the sum of 12 CPs in the OTP zone to establish the corresponding NUC rate.

Because both the NITS and NUC charges are assessed on the basis of the transmission user's average monthly coincident peak demand, we allocated the monthly transmission cost to hours within the month using the probability of a given hour's being the monthly peak. These probabilities were calculated using six years (2012 – 2017) of OTP Control Area's historical hourly loads. The allocated hourly transmission costs were adjusted by marginal losses and cash working capital, and summarized by costing period. The time-differentiated marginal transmission costs stated on a per kWh and kW basis are shown in the summary tables in section IX.

## **V. MARGINAL ANCILLARY SERVICE COSTS**

The costs of procuring ancillary services to meet incremental load in a given hour are also a marginal financial cost to OTP. Two types of ancillary services in MISO markets are Regulation and Operating Reserves (Spinning and Supplemental). OTP pays an hourly rate which is the total cost of each of these services procured by the MISO divided by the total hourly MISO load.

We used the average annual hourly cost in dollars per MWh for each type of reserve for 2017. A forecast of the hourly cost of these services for future years was not available and were assumed to increase with inflation every year. The expected average hourly cost was adjusted by marginal losses at each service voltage level and working capital.

## VI. MARGINAL DISTRIBUTION COSTS

The various components of OTP's higher voltage distribution system include distribution substations and trunkline primary feeders. Local distribution facilities include primary-to-secondary transformers and switchgear, secondary lines and local primary taps, as well as dedicated feeders used by some large primary customers.<sup>5</sup> Service drops are considered a component of the distribution costs, but in most cases the service drop serves a single customer and we included it as part of the marginal customer cost for each class along with the meter and associated equipment such as current transformer.

### A. Distribution Substation and Trunkline Feeder Costs

The distribution stations and trunkline feeders from the substation to the point where the line branches to create a primary tap line are expanded as the distribution area peak demands grow. Estimating the marginal cost of distribution substation and trunkline feeder cost per kW of demand required identifying the budgeted growth-related investments in OTP's capital expansion plan for the period 2018-2022. The sum of OTP's growth-related investment (stated in 2018 dollars) was divided by the estimated addition to distribution substation non-coincident peak demand over the same period, to obtain a marginal investment per kW.<sup>6</sup>

Distribution O&M expenses are a component of marginal distribution cost, since they grow with the amount of plant in service. The MCOS allocated OTP's FERC Form 1 distribution O&M expenses by FERC account for 2012-2016 annual distribution substation O&M expenses, plus associated overheads, were divided by estimates of the sum of non-coincident peak demands at the substations and converted to 2018 dollars. After reviewing the trend in expense per kW (in constant dollars), the average of the 2014-2016 values was considered a reasonable proxy for marginal substation O&M expenses.

To time differentiate this component, the relative probability of distribution peak for months, day-types (weekdays, Saturday, and Sunday) were estimated based on historical hourly loads on all of OTP distribution substations for the years 2012-2017. The analysis accounted for the relative lower carrying capability of this equipment in summer months as compared to the winter months. Marginal demand losses were applied to the distribution substation and trunkline feeder investment to reflect the fact that, to accommodate a kW of additional peak load at the customer's meter, facilities must be expanded by successively more than a kW to accommodate

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<sup>5</sup> This study does not calculate separate costs for such customers, since they are recovered outside of standard rates.

<sup>6</sup> OTP was only able to provide non-coincident distribution peak demand for 2016. We estimated OTP's NCP for the period 2018-2022 based on expected growth rate of OTP's annual peak demands.

the fixed and variable losses on the system in the peak hour. Peak demand loss factors were developed from OTP's 2010 loss study.

## **B. Local Distribution Facility Costs**

The local distribution facilities, including secondary lines, line transformers, and a portion of primary taps, are less extensively shared than the distribution substations. OTP designs these facilities using engineering standards that take into consideration the expected number of customers who will use those facilities and their maximum expected connected loads over the service life of the facilities. Transformers and local lines are not expanded as the load grows. Thus, the marginal cost of local distribution facilities is incurred based on design demand, not on the customer's actual peak load from month to month. The cost of local distribution facilities are marginal at the time of customer connection and at the time of replacement. There may be a different design demand at the time of replacement, which would trigger a change in the marginal cost, in addition to any change in the company's connection standards. Different design demand standards are used in rural versus urban areas, and for customers that use all electric appliances instead of relying partially on gas. Local distribution facilities for commercial and industrial customers are generally designed on a case-by-case basis, taking into consideration their expected maximum demand.

OTP provided estimates of the typical investment in local distribution facilities for various types and sizes of customers, by applying its standard distribution cost estimation to a range of typical customer characteristics. OTP also used this approach to estimate the cost of customer service drops. The marginal costs were estimated as the fixed monthly distribution cost per kW of design demand. When a design demand was not available, the transformer capacity divided by the number of customers expected to be served from that transformer was used as a proxy for the estimated design demand by class.

Marginal distribution facility O&M expenses were estimated from historical data given that there was not a forecast of O&M expenses. The average of 2014 -2016 expense per kW of design demand was separated into primary and secondary categories on the basis of miles of circuit, and used as the estimated marginal distribution facilities O&M expense. The total design demand was the product of customer counts and per-customer design demand estimates by customer category, developed by OTP from load survey data for years 2015 and 2016. The MCOS also calculated the average lighting O&M expense and distribution facilities used by lights. The average expense over the period 2014-2016 were considered a reasonable estimate of the future marginal level of these expenses.

## VII. MARGINAL CUSTOMER COSTS

### A. Meter and Service Costs

OTP provided the 2017 installed cost of a typical meter, including current transformer if applicable, and service drop for all customer categories. The average meter O&M expense in 2015 and 2016 was used to represent the marginal level of these expenses. The MCOS study separately calculated meter requirements for small power producers, which vary with the specific rider and/or jurisdictional legislation. When a bi-directional and/or a generation meter are required for reporting purposes, there are incremental costs of installing these meters. The MCOS calculated an annual installed bi-directional meter cost incremental to the regular meter cost, by rate category.

### B. Customer Accounts and Customer Expenses

Customer accounts expenses, composed mainly of meter-reading and billing expenses, are costs that are the function of a number of customers on the system. OTP's FERC Form 1 historical customer account and service expense levels for the period 2012-2016 were divided by class weighted customers to obtain an estimate of customer accounts expense per weighted customer. After considering the declining trend in expenses, the average expense per customer in 2015 and 2016 was used as an estimate of marginal expense.

Customer service and informational expenses, which include the costs of disseminating information to consumers, vary with the number of customers on the system and are, therefore, marginal.<sup>7</sup> The same procedure used for customer accounts expenses was followed using the class weights developed for these services in OTP's 2017 embedded cost of service study. Given the decrease of unit expense per customer observed in recent years, the average of 2014 through 2016 values was assumed to be a reasonable approximation of the estimated future marginal expense.

### C. One-time interconnection cost for Small Power Producer

Customers under the Small Power Producer Rider are responsible for system upgrades caused by the installation of the generation system. The most important one-time cost impact is related to the interconnection process, i.e., processing and energizing the interconnection. OTP does not currently charge any fee directly associated with the incremental expenses involved with this work and so this cost is currently shared by all customers. The MCOS estimated a typical one-time cost of interconnecting a small power producer involved estimating the time to review the

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<sup>7</sup> Expenses associated with CIP and EEP, programs mandated by MN and SD to promote demand side measures, were omitted from the study since these programs are not a marginal cost with respect to load changes.

application form filled out by customer, a site inspection, an interconnection study and a final site visit prior to the energizing of the generator.

The labor cost reflects the mid-point of the expected 2018 average hourly salary of the employees directly involved in handling the interconnection. This hourly cost was then multiplied by the 20 hours typically required to process the interconnection, excluding the time required to install a bi-directional meter, which is computed separately. The cost was then adjusted for non-plant related loaders and cash working capital to obtain a one-time marginal cost associated with processing and energizing the interconnection.

## VIII. COMPUTATION OF ANNUAL MARGINAL COSTS

The MCOS estimated annualized marginal cost for each component of service by multiplied the resulting figures by the annual economic carrying charge, expressed as a percentage, and adjusting the investment per unit by the general plant loading factor and a plant-related A&G loading factor. To these costs, we added marginal O&M, non-plant related A&G expenses, and revenue requirements for working capital to obtain the annualized marginal costs. A summary of the calculation of these components is provided below.

### A. Loaders

The 2017 MCOS included loading factors, in particular plant-related A&G, non-plant-related A&G and general plant loading factors. These are required to capture the additional plant or O&M expenses, or overhead costs incurred when electric plant or electric O&M increase. Certain administrative and general (A&G) expenses can grow either with plant or with O&M expenses. Accounts not marginal with respect to other expenses or plant must be excluded.<sup>8</sup> The MCOS uses a non-plant-related A&G loader that was estimated based on the average ratio of non-plant-related A&G expenses (FERC Accounts 926 and 408.1) to O&M expenses over the period 1982-2014, or 13.23%.

For plant-related A&G, there are two A&G FERC accounts clearly vary with the amount of plant in service: Maintenance of General Plant (FERC Account 935) and Property Insurance (FERC Account 924). Account 935 was regressed on cumulative net additions to total electric plant, all in constant dollars, for a 32-year period, yielding a loader of 0.10%. A second component of plant-related A&G was average property and terrorism insurance rate, \$0.0729 per \$100 or

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<sup>8</sup> OTP's MC study excluded FERC Accounts 922 Administrative Expenses Transferred (Credit), 923 Outside Services Employed, 927 Franchise Requirements, 928 Regulatory Requirements, 930.1 Institutional and Goodwill Advertising Expenses, and 931 Rents.

0.0729%. The total plant-related A&G loader applicable to distribution substations in the MC was 0.17%, and 0.10% for all other distribution plant that does not require insurance.

Another loading factor is the general plant, which typically grows with other types of plant. General plant consists of items such as office buildings, warehouses, cars, trucks and other equipment. Since 1996 there has been very little change in OTP's general plant. The MCOS uses a General Plant loader of 1.30% based on a regression of 20 years of cumulative net additions to general plant on cumulative net additions to total plant (less General plant).

## **B. Economic Carrying Charges**

To convert estimates of marginal distribution plant investment into annual costs requires estimating an economic carrying charge that reflects the elements of OTP's revenue requirement associated with incremental plant. Inputs to the economic carrying charge calculation include: the utility's incremental cost of capital (mix of debt and equity and their respective long-term market costs), the expected inflation rate for that type of plant, net of technical progress, and the average service life and patterns of failure ("Iowa curve") for each type of plant.

These elements were updated with OTP's latest financial information. OTP foresees financing of incremental investment through sales of common stock (52.44%) and debt (47.56%). The long-term incremental cost of debt is expected to be 5.31% and the incremental cost of common stock is expected to be 9.50%. The economic carrying charge calculation used a long-term inflation assumption of 2.5%.

## **C. Working capital**

The computation of working capital includes components for cash, materials, supplies and prepayments. The working capital needs were estimated based on recent historical amounts. The revenue requirement for this working capital was developed from OTP's weighted average cost of capital plus an income tax component that recognizes that the equity portion of return on capital is taxable.

## IX. SUMMARY OF MARGINAL COSTS FOR YEARS 2018 - 2022

The results of time-differentiated marginal costs (including energy, generation capacity, transmission and distribution substation costs), stated in 2018\$, were averaged over the years 2018 through 2022. Table 2 shows all marginal costs stated on a per-kWh basis. Table 3 shows the marginal capacity costs stated on a per-kW basis.

**Table 2. Summary of Time-differentiated Marginal per-kWh Costs, Averaged for 2018-2022**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Average 2018-2022</b>	----- (2018 Cents per kWh) -----					
<b>(1) Secondary</b>						
Energy	3.9774	3.0101	1.9834	3.3537	2.9822	2.0928
Generation Capacity	5.5095	1.9835	0.0004	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862
Transmission	2.8081	0.8274	0.0204	2.7119	0.6146	0.4343
Distribution Substation	1.4411	0.0663	0.0000	0.2617	0.2777	0.2468
Total	13.8223	5.9735	2.0905	6.4135	3.9607	2.8601
<b>Seasonal</b>	5.2718			3.7286		
<b>Annual</b>	4.2444					
<b>(2) Primary</b>						
Energy	3.8294	2.9076	1.9252	3.2106	2.8652	2.0173
Generation Capacity	5.2741	1.8997	0.0004	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0843	0.0843	0.0843	0.0843	0.0843	0.0843
Transmission	2.6891	0.7923	0.0157	2.5754	0.5824	0.4094
Distribution Substation	1.4014	0.0645	0.0000	0.2545	0.2700	0.2400
Total	13.2783	5.7484	2.0257	6.1247	3.8018	2.7509
<b>Seasonal</b>	5.0766			3.5779		
<b>Annual</b>	4.0789					
<b>(3) Transmission</b>						
Energy	3.5936	2.7428	1.8306	2.9861	2.6800	1.8969
Generation Capacity	4.9039	1.7677	0.0004	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0809	0.0809	0.0809	0.0809	0.0809	0.0809
Transmission	2.0289	0.6048	0.0246	1.9190	0.4402	0.3098
Distribution Substation	0.6035	0.1778	0.0044	0.5707	0.1286	0.0897
Total	11.2108	5.3740	1.9408	5.5567	3.3297	2.3773
<b>Seasonal</b>	4.5566			3.1413		
<b>Annual</b>	3.6143					

**Table 3. Summary of Marginal Time-Differentiated per-kW Capacity Costs and Marginal Energy and Operating Reserve per-kWh Costs, Averaged for 2018-2022**

<b>Average 2018-2022</b>	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Secondary</b>						
Monthly Costs per Kilowatt (2018 Dollars per Kilowatt)						
Generation Capacity	\$7.202	\$4.062	\$0.002	\$0.000	\$0.000	\$0.000
Transmission	\$3.671	\$1.694	\$0.081	\$2.354	\$1.813	\$1.508
Distribution Substation	\$1.884	\$0.136	\$0.000	\$0.227	\$0.819	\$0.857
<b>Total</b>	\$12.76	\$5.89	\$0.08	\$2.58	\$2.63	\$2.36
<b>Seasonal</b>	\$18.73			\$7.58		
<b>Annual</b>	\$11.30					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.9774	3.0101	1.9834	3.3537	2.9822	2.0928
Regulation and Op. Reserves	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862
<b>Total</b>	4.0636	3.0964	2.0696	3.4399	3.0685	2.1790
<b>Seasonal</b>	2.7129			2.6891		
<b>Annual</b>	2.6971					
<b>Primary</b>						
Monthly Costs per Kilowatt (2018 Dollars per Kilowatt)						
Generation Capacity	\$6.894	\$3.890	\$0.002	\$0.000	\$0.000	\$0.000
Transmission	\$3.515	\$1.623	\$0.062	\$2.235	\$1.718	\$1.421
Distribution Substation	\$1.832	\$0.132	\$0.000	\$0.221	\$0.797	\$0.833
<b>Total</b>	\$12.24	\$5.64	\$0.06	\$2.46	\$2.52	\$2.25
<b>Seasonal</b>	\$17.95			\$7.23		
<b>Annual</b>	\$10.80					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.8294	2.9076	1.9252	3.2106	2.8652	2.0173
Regulation and Op. Reserves	0.0843	0.0843	0.0843	0.0843	0.0843	0.0843
<b>Total</b>	3.9137	2.9919	2.0095	3.2949	2.9494	2.1016
<b>Seasonal</b>	2.6244			2.5868		
<b>Annual</b>	2.5994					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2018 Dollars per Kilowatt)						
Generation Capacity	\$6.410	\$3.620	\$0.002	\$0.000	\$0.000	\$0.000
Transmission	\$2.652	\$1.239	\$0.097	\$1.665	\$1.299	\$1.076
Distribution Substation						
<b>Total</b>	\$9.06	\$4.86	\$0.10	\$1.67	\$1.30	\$1.08
<b>Seasonal</b>	\$14.02			\$4.04		
<b>Annual</b>	\$7.37					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.5936	2.7428	1.8306	2.9861	2.6800	1.8969
Regulation and Op. Reserves	0.0809	0.0809	0.0809	0.0809	0.0809	0.0809
<b>Total</b>	3.6745	2.8236	1.9114	3.0670	2.7608	1.9778
<b>Seasonal</b>	2.4815			2.4244		
<b>Annual</b>	2.4435					



Table 4 summarizes monthly marginal local distribution facilities costs, stated both as a fixed cost per kW of customer’s design demand and as a fixed cost per customer by class, using a measure of typical design demand in the class.

**Table 4: Summary of Monthly Marginal Local Distribution Facilities (and Lighting) Costs**

Customer Class	Monthly Facility Cost per kW of Design Demand (\$/kW)	Estimate of Typical Design Demand by Customer kW	Monthly Facility Cost per Customer (\$/customer/mo.)
<b>Residential</b>			
Urban	\$1.45	8	\$12.10
Rural	\$2.75	18	48.07
Apartment, Gas	\$1.28	5	5.80
Apartment, Elec	\$0.91	9	8.29
<b>Farm</b>	\$2.78	18	48.64
<b>Small Commercial</b>			
Stand-Alone customer, overhead	\$0.71	50	35.28
Stand-Alone customer 3ph, overhead	\$0.85	75	64.11
Shared-customer 3ph, overhead	\$0.91	75	68.38
Stand-Alone customer, underground	\$1.17	50	58.39
Stand-Alone 3ph, underground	\$1.38	75	103.80
<b>Large Commercial (Secondary)</b>			
101-150kVa, 3ph	\$1.02	150	152.93
151-300kVa, 3ph	\$0.78	300	233.56
301-500kVa, 3ph	\$0.67	500	334.47
501-1000 kVa, 3ph	\$0.62	1,000	621.21
<b>Very Large Commercial (Secondary)</b>			
1001-1500kVa, 3ph	\$0.58	1,500	869.60
1501-2000kVa, 3ph	\$0.56	2,000	1,118.80
<b>Very Large Commercial (Primary)</b>			
3000kVa	\$0.49	3,000	1,456.48
5000kVa	\$0.47	5,000	2,331.80
<b>Lighting</b>			\$/Fixture
Area Light, underground			10.75
Area Light, overhead			9.77
Street Light, underground			6.13
Street Light, overhead			5.14

Table 5 summarizes the monthly marginal customer cost by customer class. Tables 6 and 7 summarize the monthly marginal cost and the one-time connection cost of small power producers.

**Table 5. Summary of Monthly Marginal Customer Costs**

		Monthly Marginal Customer Cost <u>(2018\$/mo.)</u>
<b>Residential</b>		
9.01	Residential	15.44
9.02	Residential Controlled Demand	20.42
14.01	Residential Water Heating Control Rider	5.63
14.04	Residential Controlled Service - Large Dual Fuel Rider	18.05
14.05	Residential Controlled Service - Small Dual Fuel Rider	4.22
14.06	Residential Controlled Service - Deferred Load Rider	6.44
14.07	Residential Fixed Time of Service Rider	4.08
11.03, 11.04	Residential Outdoor/Area Lighting	0.30
<b>Commercial and Industrial</b>		
9.03	Farm Service	17.67
10.01	General Service < 20 kW	25.30
10.02	General Service >= 20 kW	32.57
10.04	Large Commercial Service - Secondary	225.79
	Large Commercial Service - Primary	292.96
10.05	Large General Service - Time of Day (Secondary)	225.79
	Large General Service - Time of Day (Primary)	292.96
14.01	Commercial Water Heating Control Rider	5.63
14.02	Large GS - Real Time Pricing Rider (Secondary)	226.51
	Large GS - Real Time Pricing Rider (Primary)	292.96
14.04	Commercial Controlled Service - Large Dual Fuel Rider	20.46
14.05	Commercial Controlled Service - Small Dual Fuel Rider	8.02
14.06	Commercial Controlled Service - Deferred Load	8.91
14.07	Commercial Fixed Time of Service Rider	6.76
11.02	Irrigation	24.65
10.03	General Service - Time of Use	229.16
11.03, 11.04	Commercial Outdoor/Area Lighting	0.30
Miscellaneous		
11.03, 11.04	Street Lighting	0.30
11.05, 11.06	Other Public Authority	27.19

**Table 6. Monthly Marginal Customer Cost for Small Power Producers, by Rate Class**

	Monthly Incremental Customer Cost (2018\$/cust/mo.)
<b>Residential Small Power Producer</b>	
Residential	0.83
Residential Demand Control	0.79
<b>Commercial and Industrial Small Power Producer</b>	
General Service <20 kW	1.07
General Service >= 20 kW	1.07
Farm Service	0.86
General Service - Time of Use	1.13
Large General Service (Secondary)	1.21
Large General Service (Primary)	1.25
Large General Service - Time of Day (Secondary)	1.21
Large General Service - Time of Day (Primary)	1.25
Irrigation Service	1.20

**Table 7. One-Time Expense per Interconnection of Small Power Producer**

	Interconnection Labor Cost
<u>Small Power Producer Rider</u>	(2018\$)
Average Annual Salary of Technical & Admin Personnel Involved	\$96,516.21
Annual hours net of paid vacation & holiday	1,880.00
Hourly average labor cost	\$51.34
Hours required per interconnection	\$20.00
Expense per Interconnection Request	\$1,026.77
With Non-Plant Related A&G	\$1,162.60
Working Capital	
Cash Working Capital	77.55
Revenue Requirement for Working Capital	\$7.20
Total One-time Incremental Cost to Process and Energize Interconnection	\$1,169.80

## **APPENDIX 1: DERIVATION OF ANNUAL MARGINAL COSTS**

Tables A.1.1 through A.1.11 show the derivation of the annualized distribution substation and trunkline feeder costs, annualized marginal cost for local distribution facilities and lighting, and annualized cost of meters and service drops, as well as other marginal customer-related expenses. Tables A.1.12 through A. 1. 16 show the annual summary of time-differentiated costs of energy and capacity for each year 2018 through 2022.

**Table A.1.1. Annualized Distribution Substation Costs**

	2018 Dollars per kW
Marginal Investment per kW	\$236.55
With General Plant Loading	239.63
Annual Economic Carrying Charge Related to Capital Investment	7.84%
A&G Loading (plant related)	0.17%
Total Annual Carrying Charge	8.01%
Annualized Costs	19.20
O&M Expenses	1.54
With A&G	1.75
Subtotal	20.95
Working Capital	
Material and Supplies	2.47
Prepayments	0.07
Cash Working Capital Allowance	0.12
Total Working Capital	2.66
Revenue Requirement for Working Capital	0.25
Total Distribution Substation Annual Cost	\$21.20

**Table A.1.2 Annualized Distribution Facilities Costs, Residential**

	<b>Residential</b>				
	Single Family Urban	Single Family Rural	Apartment Gas	Apartment Electric	Farm
	----- (2018 Dollars per kW) -----				
Marginal Investment per kW	\$173.03	\$392.78	\$143.06	\$81.38	\$398.28
With General Plant Loading	175.28	397.89	144.92	82.44	403.46
Annual Economic Carrying Charge Related to					
Capital Investment	6.78%	6.78%	6.78%	6.78%	6.78%
A&G Loading (plant-related)	0.10%	0.10%	0.10%	0.10%	0.10%
Total Annual Carrying Charge	6.88%	6.88%	6.88%	6.88%	6.88%
Annualized Costs	12.06	27.38	9.97	5.67	27.76
O&M Expense per kW	4.56	4.56	4.56	4.56	4.56
With A&G Loading (non-plant related)	5.16	5.16	5.16	5.16	5.16
Distribution Facilities Related Costs	17.22	32.54	15.13	10.83	32.92
Working Capital					
Material and Supplies	1.81	4.10	1.49	0.85	4.16
Prepayments	0.05	0.12	0.04	0.02	0.12
Cash Working Capital Allowance	0.34	0.34	0.34	0.34	0.34
Total Working Capital	2.20	4.56	1.88	1.22	4.62
Revenue Requirement for Working Capital	0.20	0.42	0.17	0.11	0.43
Total Annual Marginal Distribution Facilities Related Costs	\$17.43	\$32.96	\$15.31	\$10.95	\$33.35

**Table A.1.3. Annualized Distribution Facilities Costs, Small Commercial**

	<b>Small Commercial</b>				
	Stand-Alone customer, overhead	Stand-Alone customer 3ph, overhead	Shared- customer 3ph, overhead	Stand-Alone customer, underground	Stand-Alone 3ph, underground
	----- (2018 Dollars per kW) -----				
Marginal Investment per kW	\$46.32	\$71.64	\$81.31	\$124.77	161.46
With General Plant Loading	46.92	72.57	82.36	126.39	163.55
Annual Economic Carrying Charge Related to					
Capital Investment	6.78%	6.78%	6.78%	6.78%	6.78%
A&G Loading (plant-related)	0.10%	0.10%	0.10%	0.10%	0.10%
Total Annual Carrying Charge	6.88%	6.88%	6.88%	6.88%	6.88%
Annualized Costs	3.23	4.99	5.67	8.70	11.25
O&M Expense per kW	4.56	4.56	4.56	4.56	4.56
With A&G Loading	5.16	5.16	5.16	5.16	5.16
(non-plant related)					
Distribution Facilities Related Costs	8.39	10.15	10.83	13.86	16.42
Working Capital					
Material and Supplies	0.48	0.75	0.85	1.30	1.68
Prepayments	0.01	0.02	0.02	0.04	0.05
Cash Working Capital Allowan	0.34	0.34	0.34	0.34	0.34
Total Working Capital	0.84	1.11	1.22	1.68	2.08
Revenue Requirement for Working Capital	0.08	0.10	0.11	0.16	0.19
Total Annual Marginal Distribution Facilities Related Costs	\$8.47	\$10.26	\$10.94	\$14.01	\$16.61

**Table A.1.4. Annualized Distribution Facilities Costs, Large Commercial**

	Large Commercial (Secondary)				Very Large Commercial (Secondary TOU)		Large Commercial (Primary)	
	101- 150kVa, 3ph	151- 300kVa, 3ph	301- 500kVa, 3ph	501- 1000 kVa, 3ph	1001- 1500 kVa, 3ph	1501- 2000 kVa, 3ph	3000 kVa (LGS), 3ph	5000 kVa (LGS TOU), 3ph
	----- (2018 Dollars per kW) -----							
Marginal Investment per kW	\$99.59	\$58.69	\$40.08	\$31.98	\$24.94	\$21.49	\$8.95	\$5.70
With General Plant Loading	100.89	59.45	40.60	32.40	25.27	21.77	9.06	5.77
Annual Economic Carrying Charge Related to								
Capital Investment	6.78%	6.78%	6.78%	6.78%	6.78%	6.78%	6.78%	6.78%
A&G Loading (plant-related)	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
Total Annual Carrying Charge	6.88%	6.88%	6.88%	6.88%	6.88%	6.88%	6.88%	6.88%
Annualized Costs	6.94	4.09	2.79	2.23	1.74	1.50	0.62	0.40
O&M Expense per kW	4.56	4.56	4.56	4.56	4.56	4.56	4.56	4.56
With A&G Loading (non-plant related)	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16
Distribution Facilities Related Costs	12.10	9.25	7.96	7.39	6.90	6.66	5.79	5.56
Working Capital								
Material and Supplies	1.04	0.61	0.42	0.33	0.26	0.22	0.09	0.06
Prepayments	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00
Cash Working Capital Allowance	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Total Working Capital	1.41	0.97	0.77	0.69	0.61	0.58	0.44	0.41
Revenue Requirement for Working Capital	0.13	0.09	0.07	0.06	0.06	0.05	0.04	0.04
Total Annual Marginal Distribution Facilities Related Costs	\$12.23	\$9.34	\$8.03	\$7.45	\$6.96	\$6.71	\$5.83	\$5.60



**Table A.1.5. Annualized Lighting Costs**

	<b>Lighting</b>			
	Area Light, underground	Area Light, overhead	Street Light, underground	Street Light, overhead
	----- (2018 Dollars per fixture) -----			
Marginal Investment per fixture	\$1,401.38	\$1,233.64	\$616.82	\$449.09
With General Plant Loading	1,419.59	1,249.68	624.84	454.93
Annual Economic Carrying Charge Related to				
Capital Investment	6.78%	6.78%	6.78%	6.78%
A&G Loading (plant-related)	0.10%	0.10%	0.10%	0.10%
Total Annual Carrying Charge	6.88%	6.88%	6.88%	6.88%
Annualized Costs	97.68	85.99	42.99	31.30
Lighting O&M Expenses	26.31	26.31	26.31	26.31
With A&G Loading	29.79	29.79	29.79	29.79
(non-plant related)				
Distribution Facilities Related Costs	127.47	115.78	72.78	61.09
Working Capital				
Material and Supplies	14.62	12.87	6.44	4.69
Prepayments	0.43	0.37	0.19	0.14
Cash Working Capital Allowance	1.99	1.99	1.99	1.99
Total Working Capital	17.03	15.23	8.61	6.81
Revenue Requirement for Working Capital	1.58	1.41	0.80	0.63
Total Annual Marginal Distribution Facilities Related Costs	\$129.05	\$117.19	\$73.58	\$61.72

**Table A.1.6. Annualized Residential Customer-Related Marginal Costs (i)**

	Residential	Residential Demand Control	Residential Water Heating Control Rider	Residential Controlled Service - Large Dual Fuel Rider	Residential Controlled Service - Small Dual Fuel Rider
----- (2018 Dollars per Customer) -----					
<b>a) Investment - Meter Costs</b>					
Meter Cost Investment per Customer	\$120.49	\$519.81	\$415.84	\$1,978.59	\$423.11
With General Plant Loading	122.05	526.56	421.25	2,004.31	428.61
Annual Economic Charge Related to Capital Investment	9.27%	9.27%	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%	9.37%	9.37%
Total Annualized Meter Costs	11.44	49.34	39.48	187.83	40.17
<b>b) Investment - Meter Service Drops</b>					
Service Cost Investment per Customer	\$586.71	\$586.71	\$0.00	\$0.00	\$0.00
With General Plant Loading	594.33	594.33	0.00	0.00	0.00
Annual Economic Charge Related to Capital Investment	6.78%	6.78%	6.78%	6.78%	6.78%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Services	6.88%	6.88%	6.88%	6.88%	6.88%
Total Annualized Service Costs	40.90	40.90	0.00	0.00	0.00
<b>c) O&amp;M - Meter, Customer Accounts Expenses, Customer Service</b>					
Meter and CT O&M Expenses	8.21	10.95	8.21	8.21	8.21
Customer Accounts Expenses	87.43	103.41	15.98	14.72	0.00
Customer Service and Informational E: With A&G (Non-plant Related)	20.95 132.01	21.08 153.36	0.13 27.54	0.58 26.62	0.58 9.95
Customer-Related Costs	184.35	243.60	67.01	214.45	50.12
Working Capital					
Materials and Supplies	1.26	5.42	4.34	20.64	4.41
Prepayments	0.04	0.16	0.13	0.60	0.13
Cash Working Capital	8.81	10.23	1.84	1.78	0.66
Revenue Requirement for Working Capital	0.94	1.47	0.58	2.14	0.48
Total Annual Marginal Customer-Related Costs	\$185.28	\$245.06	\$67.60	\$216.58	\$50.60

**Table A.1.6. Annualized Residential Customer-Related Marginal Costs (ii)**

	Residential Controlled Service - Deferred Load Rider	Residential Fixed Time of Service Rider	Residential Outdoor/ Area Lighting
<u>a) Investment - Meter Costs</u>			
Meter Cost Investment per Customer	\$533.27	\$237.91	n/a
With General Plant Loading	540.20	241.00	0.00
Annual Economic Charge Related to Capital Investment	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%
Total Annualized Meter Costs	50.62	22.58	0.00
<u>b) Investment - Meter Service Drops</u>			
Service Cost Investment per Customer	\$0.00	\$0.00	n/a
With General Plant Loading	0.00	0.00	0.00
Annual Economic Charge Related to Capital Investment	6.78%	6.78%	6.78%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%
Total Carrying Charge Services	6.88%	6.88%	6.88%
Total Annualized Service Costs	0.00	0.00	0.00
<u>c) O&amp;M - Meter, Customer Accounts Expenses, Customer Service</u>			
Meter and CT O&M Expenses	8.21	8.21	0.00
Customer Accounts Expenses	14.19	14.19	2.66
Customer Service and Informational E:	0.56	0.56	0.47
With A&G (Non-plant Related)	26.00	26.00	3.54
Customer-Related Costs	76.62	48.58	3.54
Working Capital			
Materials and Supplies	5.56	2.48	0.00
Prepayments	0.16	0.07	0.00
Cash Working Capital	1.73	1.73	0.24
Revenue Requirement for Working Capital	0.69	0.40	0.02
Total Annual Marginal Customer-Related Costs	\$77.31	\$48.98	\$3.57

**Table A.1.7. Annualized General Service Customer-Related Marginal Costs**

	General Service < 20 kW	General Service >= 20 kW	Farm Service	Large Commercial Secondary	Large Commercial Primary	General Service - Time of Use
	----- (2018 Dollars per Customer) -----					
<u>a) Investment - Meter Costs</u>	(1)	(2)	(3)	(4)	(5)	(1)
Meter Cost Investment per Customer	\$705.79	\$705.79	\$423.88	\$1,744.38	\$9,549.89	\$1,568.68
With General Plant Loading	714.96	714.96	429.39	1,767.06	9,674.04	1,589.07
Annual Economic Charge Related to						
Capital Investment	9.27%	9.27%	9.27%	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%	9.37%	9.37%	9.37%
Total Annualized Meter Costs	67.00	67.00	40.24	165.59	906.56	148.91
<u>b) Investment - Meter Service Drops</u>						
Service Cost Investment per Customer	\$879.73	\$1,716.37	\$621.57	\$27,581.04	\$28,403.08	\$28,403.08
With General Plant Loading	891.17	1,738.68	629.65	27,939.60	28,772.32	28,772.32
Annual Economic Charge Related to						
Capital Investment	6.78%	6.78%	6.78%	6.78%	6.78%	6.78%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Services	6.88%	6.88%	6.88%	6.88%	6.88%	6.88%
Total Annualized Service Costs	61.32	119.64	43.33	1,922.48	1,979.78	1,979.78
<u>c) O&amp;M - Meter, Customer Accounts Expenses, Customer Service</u>						
Meter and CT O&M Expenses	8.21	33.60	10.95	403.24	403.24	403.24
Customer Accounts Expenses	124.26	124.26	82.60	38.37	38.37	38.37
Customer Service and Informational Exp	20.77	20.77	18.82	102.27	102.27	102.27
With A&G (Non-plant Related)	173.51	202.26	127.24	615.83	615.83	615.83
Customer-Related Costs	301.83	388.90	210.80	2,703.90	3,502.17	2,744.52
Working Capital						
Materials and Supplies	7.36	7.36	4.42	18.20	99.64	16.37
Prepayments	0.21	0.21	0.13	0.53	2.90	0.48
Cash Working Capital	11.57	13.49	8.49	41.08	41.08	41.08
Revenue Requirement for Working Capital	1.78	1.96	1.21	5.55	13.33	5.37
Total Annual Marginal Customer-Related Costs	\$303.61	\$390.85	\$212.01	\$2,709.45	\$3,515.50	\$2,749.90

**Table A.1.8. Annualized Large GS Customer-Related Marginal Costs**

	Large GS (Real Time Pricing) Secondary	Large GS (Real Time Pricing) Primary	Large GS - TOD Secondary	Large GS - TOD Primary
	----- (2018 Dollars per Customer) -----			
a) Investment - Meter Costs	(1)	(2)	(3)	(4)
Meter Cost Investment per Customer	\$1,834.37	\$9,549.89	\$1,744.38	\$9,549.89
With General Plant Loading	1,858.22	9,674.04	1,767.06	9,674.04
Annual Economic Charge Related to				
Capital Investment	9.27%	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%	9.37%
Total Annualized Meter Costs	174.14	906.56	165.59	906.56
b) Investment - Meter Service Drops				
Service Cost Investment per Customer	\$27,581.04	\$28,403.08	\$27,581.04	\$28,403.08
With General Plant Loading	27,939.60	28,772.32	27,939.60	28,772.32
Annual Economic Charge Related to				
Capital Investment	6.78%	6.78%	6.78%	6.78%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Services	6.88%	6.88%	6.88%	6.88%
Total Annualized Service Costs	1,922.48	1,979.78	1,922.48	1,979.78
c) O&M - Meter, Customer Accounts Expenses, Customer Service				
Meter and CT O&M Expenses	403.24	403.24	403.24	403.24
Customer Accounts Expenses	38.37	38.37	38.37	38.37
Customer Service and Informational E:	102.27	102.27	102.27	102.27
With A&G (Non-plant Related)	615.83	615.83	615.83	615.83
Customer-Related Costs	2,712.44	3,502.17	2,703.90	3,502.17
Working Capital				
Materials and Supplies	19.14	99.64	18.20	99.64
Prepayments	0.56	2.90	0.53	2.90
Cash Working Capital	41.08	41.08	41.08	41.08
Revenue Requirement for Working Capital	5.64	13.33	5.55	13.33
Total Annual Marginal Customer-Related Costs	\$2,718.08	\$3,515.50	\$2,709.45	\$3,515.50

**Table A.1.9. Annualized GS Customer-Related Marginal Costs for Riders**

	Commercial Water Heating Control	Commercial Controlled Service - Large Dual Fuel (14.04)	Commercial Controlled Service - Small Dual Fuel (14.05)	Commercial Controlled Service - Deferred Load (14.06)	Small Commercial Fixed Time of Service (14.07)
----- (2018 Dollars per Customer) -----					
<u>a) Investment - Meter Costs</u>	(1)	(2)	(3)	(4)	(5)
Meter Cost Investment per Customer	\$415.84	\$1,978.59	\$423.11	\$533.27	\$533.27
With General Plant Loading	421.25	2,004.31	428.61	540.20	540.20
Annual Economic Charge Related to Capital Investment	9.27%	9.27%	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%	9.37%	9.37%
Total Annualized Meter Costs	39.48	187.83	40.17	50.62	50.62
<u>c) O&amp;M - Meter, Customer Accounts Expenses, Customer Service</u>					
Meter and CT O&M Expenses	8.21	33.60	33.60	33.60	10.95
Customer Accounts Expenses	15.98	14.72	14.72	14.72	14.72
Customer Service and Informational	0.13	0.58	0.58	0.58	0.58
With A&G (Non-plant Related)	27.54	55.37	55.37	55.37	29.72
Customer-Related Costs	67.01	243.19	95.53	105.99	80.34
Working Capital					
Materials and Supplies	4.34	20.64	4.41	5.56	5.56
Prepayments	0.13	0.60	0.13	0.16	0.16
Cash Working Capital	1.84	3.69	3.69	3.69	1.98
Revenue Requirement for Working Capital	0.58	2.31	0.76	0.87	0.72
Total Annual Marginal Customer-Related Costs	\$67.60	\$245.51	\$96.30	\$106.87	\$81.06

**Table A.1.10. Annualized Irrigation and OPA Customer-Related Costs**

	Irrigation (11.02)	Other Public Authority
<u>a) Investment - Meter Costs</u>		
Meter Cost Investment per Customer	\$1,245.54	\$437.73
With General Plant Loading	1,261.73	443.42
Annual Economic Charge Related to Capital Investment	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%
Total Annualized Meter Costs	118.24	41.55
<u>b) Investment - Meter Service Drops</u>		
Service Cost Investment per Customer	\$586.71	\$1,716.37
With General Plant Loading	594.33	1,738.68
Annual Economic Charge Related to Capital Investment	6.78%	6.78%
A&G Loading (Plant Related)	0.10%	0.10%
Total Carrying Charge Services	6.88%	6.88%
Total Annualized Service Costs	40.90	119.64
<u>c) O&amp;M - Meter, Customer Accounts Expenses, Customer Service</u>		
Meter and CT O&M Expenses	25.20	33.60
Customer Accounts Expenses	83.16	91.97
Customer Service and Informational Expe	10.53	18.95
With A&G (non-plant related)	134.62	163.64
Customer-Related Costs	293.75	324.83
Working Capital		
Materials and Supplies	13.00	4.57
Prepayments	0.38	0.13
Cash Working Capital	8.98	10.91
Revenue Requirement for Working Ca	2.07	1.45
Total Annual Marginal Customer-Related Costs	\$295.82	\$326.28



**Table A.1.11. Incremental Annualized Meter Cost for Small Power Producers by Rate Class (i)**

	Residential	Residential Demand Control	General Service < 20 kW	General Service >= 20 kW	Farm Service
----- (2018 Dollars per Customer) -----					
<u>Incremental Bi-directional Meter Costs for Small PP</u>					
Meter Cost Investment per Customer	\$103.96	\$99.24	\$134.44	\$134.44	107.49
With General Plant Loading	105.31	100.53	136.19	136.19	108.89
Annual Economic Charge Related to Capital Investment	9.27%	9.27%	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%	9.37%	9.37%
Total Annualized Meter Costs	9.87	9.42	12.76	12.76	10.20
<u>Working Capital</u>					
Materials and Supplies	1.08	1.04	1.40	1.40	1.12
Prepayments	0.03	0.03	0.04	0.04	0.03
Revenue Requirement for Working Capital	0.10	0.10	0.13	0.13	0.11
Total Annual Incremental Bi-Directional Meter Costs	\$9.97	\$9.52	\$12.90	\$12.90	\$10.31

**Table A.1.11. Incremental Annualized Meter Cost for Small Power Producers by Rate Class (ii)**

	General Service - Time of Use	Large Commercial Secondary	Large Commercial Primary	Large GS - TOD Secondary	Large GS - TOD Primary	Irrigation (11.02)
----- (2018 Dollars per Customer) -----						
<u>Incremental Bi-directional Meter Costs for Small PP</u>						
Meter Cost Investment per Customer	141.82	150.97	156.25	150.97	156.25	149.90
With General Plant Loading	143.67	152.93	158.28	152.93	158.28	151.85
Annual Economic Charge Related to Capital Investment	9.27%	9.27%	9.27%	9.27%	9.27%	9.27%
A&G Loading (Plant Related)	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
Total Carrying Charge Meters	9.37%	9.37%	9.37%	9.37%	9.37%	9.37%
Total Annualized Meter Costs	13.46	14.33	14.83	14.33	14.83	14.23
<u>Working Capital</u>						
Materials and Supplies	1.48	1.58	1.63	1.58	1.63	1.56
Prepayments	0.04	0.05	0.05	0.05	0.05	0.05
Revenue Requirement for Working Capital	0.14	0.15	0.16	0.15	0.16	0.15
Total Annual Incremental Bi-Directional Meter Costs	\$13.60	\$14.48	\$14.99	\$14.48	\$14.99	\$14.38





**Table A.1.12. 2018 Summary of Time-differentiated Marginal Costs per kWh**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
----- (2018 Cents per kWh) -----						
<b>Secondary</b>						
Energy	4.0764	3.0868	2.0284	3.4847	3.1027	2.2068
Generation Capacity	0.5637	0.2029	0.0000	0.0000	0.0000	0.0000
Regulation and Op. Reserves	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862
Transmission	2.9840	0.8792	0.0217	2.8818	0.6531	0.4615
Distribution Substation	1.4411	0.0663	0.0000	0.2617	0.2777	0.2468
Total	9.1514	4.3215	2.1364	6.7144	4.1197	3.0013
<b>Seasonal</b>	4.0004			3.8960		
<b>Annual</b>	3.9309					
<b>Primary</b>						
Energy	3.9250	2.9819	1.9690	3.3363	2.9811	2.1270
Generation Capacity	0.5396	0.1943	0.0000	0.0000	0.0000	0.0000
Regulation and Op. Reserves	0.0843	0.0843	0.0843	0.0843	0.0843	0.0843
Transmission	2.8576	0.8420	0.0207	2.7367	0.6189	0.4350
Distribution Substation	1.4014	0.0645	0.0000	0.2545	0.2700	0.2400
Total	8.8078	4.1670	2.0742	6.4118	3.9543	2.8863
<b>Seasonal</b>	3.8621			3.7383		
<b>Annual</b>	3.7797					
<b>Transmission</b>						
Energy	3.6837	2.8131	1.8723	3.1035	2.7887	1.9999
Generation Capacity	0.5017	0.1808	0.0000	0.0000	0.0000	0.0000
Regulation and Op. Reserves	0.0809	0.0809	0.0809	0.0809	0.0809	0.0809
Transmission	2.6586	0.7834	0.0193	2.5138	0.5666	0.3949
Distribution Substation						
Total	6.9248	3.8581	1.9725	5.6983	3.4362	2.4758
<b>Seasonal</b>	3.3844			3.2481		
<b>Annual</b>	3.2937					



**Table A.1.13. 2019 Summary of Time-differentiated Marginal Costs per kWh**

		Summer Season			Winter Season		
		Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
		----- (2019 Cents per kWh) -----					
<b>Secondary</b>							
	Energy	4.1340	3.1649	2.1159	3.4464	3.0612	2.1393
	Generation Capacity	1.2506	0.4502	0.0001	0.0000	0.0000	0.0000
	Regulation and Op. Reserves	0.0880	0.0880	0.0880	0.0880	0.0880	0.0880
	Transmission	2.9602	0.8722	0.0215	2.8588	0.6479	0.4578
	Distribution Substation	1.4699	0.0676	0.0000	0.2669	0.2832	0.2517
	Total	9.9027	4.6429	2.2255	6.6601	4.0802	2.9368
	<b>Seasonal</b>	4.2727			3.8429		
	<b>Annual</b>	3.9866					
<b>Primary</b>							
	Energy	3.9803	3.0572	2.0540	3.2991	2.9408	2.0621
	Generation Capacity	1.1972	0.4312	0.0001	0.0000	0.0000	0.0000
	Regulation and Op. Reserves	0.0860	0.0860	0.0860	0.0860	0.0860	0.0860
	Transmission	2.8347	0.8353	0.0206	2.7149	0.6139	0.4315
	Distribution Substation	1.4294	0.0658	0.0000	0.2595	0.2754	0.2448
	Total	9.5276	4.4754	2.1607	6.3595	3.9161	2.8244
	<b>Seasonal</b>	4.1238			3.6871		
	<b>Annual</b>	3.8331					
<b>Transmission</b>							
	Energy	3.7352	2.8840	1.9532	3.0682	2.7504	1.9390
	Generation Capacity	1.1131	0.4012	0.0001	0.0000	0.0000	0.0000
	Regulation and Op. Reserves	0.0825	0.0825	0.0825	0.0825	0.0825	0.0825
	Transmission	2.6373	0.7771	0.0191	2.4938	0.5621	0.3918
	Distribution Substation						
	Total	7.5681	4.1448	2.0549	5.6444	3.3950	2.4133
	<b>Seasonal</b>	3.6241			3.1953		
	<b>Annual</b>	3.3386					



**Table A.1.14. 2020 Summary of Time-differentiated Marginal Costs per kWh**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
----- (2020 Cents per kWh) -----						
<b>Secondary</b>						
Energy	4.0918	3.0962	2.0344	3.4678	3.0818	2.1591
Generation Capacity	5.0773	1.8279	0.0004	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0897	0.0897	0.0897	0.0897	0.0897	0.0897
Transmission	2.9121	0.8580	0.0211	2.8123	0.6373	0.4504
Distribution Substation	1.4993	0.0690	0.0000	0.2722	0.2889	0.2568
Total	13.6702	5.9408	2.1457	6.6421	4.0977	2.9559
<b>Seasonal</b>	5.2654			3.8569		
<b>Annual</b>	4.3277					
<b>Primary</b>						
Energy	3.9395	2.9907	1.9747	3.3197	2.9608	2.0813
Generation Capacity	4.8603	1.7506	0.0004	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0877	0.0877	0.0877	0.0877	0.0877	0.0877
Transmission	2.7887	0.8217	0.0202	2.6708	0.6040	0.4245
Distribution Substation	1.4580	0.0671	0.0000	0.2647	0.2809	0.2497
Total	13.1342	5.7178	2.0831	6.3429	3.9333	2.8432
<b>Seasonal</b>	5.0734			3.7011		
<b>Annual</b>	4.1598					
<b>Transmission</b>						
Energy	3.6968	2.8211	1.8776	3.0875	2.7693	1.9573
Generation Capacity	4.5191	1.6290	0.0004	0.0000	0.0000	0.0000
Regulation and Op. Reserves	0.0841	0.0841	0.0841	0.0841	0.0841	0.0841
Transmission	2.5945	0.7645	0.0188	2.4533	0.5530	0.3854
Distribution Substation						
Total	10.8945	5.2987	1.9809	5.6249	3.4065	2.4268
<b>Seasonal</b>	4.5008			3.2041		
<b>Annual</b>	3.6375					



**Table A.1.15. 2021 Summary of Time-differentiated Marginal Costs per kWh**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
----- (2021 Cents per kWh) -----						
<b>Secondary</b>						
Energy	4.1994	3.1529	2.0633	3.5294	3.1379	2.1789
Generation Capacity	9.2730	3.3384	0.0008	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0915	0.0915	0.0915	0.0915	0.0915	0.0915
Transmission	2.8756	0.8473	0.0209	2.7770	0.6294	0.4447
Distribution Substation	1.5293	0.0704	0.0000	0.2777	0.2947	0.2619
Total	17.9689	7.5004	2.1765	6.6758	4.1534	2.9771
<b>Seasonal</b>	6.4860			3.8935		
<b>Annual</b>	4.7600					
<b>Primary</b>						
Energy	4.0431	3.0454	2.0027	3.3788	3.0148	2.1003
Generation Capacity	8.8768	3.1973	0.0007	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0894	0.0894	0.0894	0.0894	0.0894	0.0894
Transmission	2.7537	0.8114	0.0000	2.6372	0.5964	0.4192
Distribution Substation	1.4872	0.0684	0.0000	0.2700	0.2865	0.2547
Total	17.2503	7.2120	2.0929	6.3756	3.9871	2.8636
<b>Seasonal</b>	6.2317			3.7365		
<b>Annual</b>	4.5705					
<b>Transmission</b>						
Energy	3.7940	2.8726	1.9040	3.1427	2.8199	1.9750
Generation Capacity	8.2537	2.9752	0.0007	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0858	0.0858	0.0858	0.0858	0.0858	0.0858
Operating Reserve	0.0526	0.0526	0.0526	0.0526	0.0526	0.0526
Transmission	2.5619	0.7549	0.0186	2.4225	0.5460	0.3806
Distribution Substation						
<b>Total</b>	14.7480	6.7410	2.0617	5.7036	3.5044	2.4939
<b>Seasonal</b>	5.6362			3.2850		
<b>Annual</b>	4.0709					



**Table A.1.16. 2022 Summary of Time-differentiated Marginal Costs per kWh**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
----- (2022 Cents per kWh) -----						
<b>Secondary</b>						
Energy	4.1863	3.1541	2.0721	3.5135	3.1264	2.1988
Generation Capacity	13.1403	4.7307	0.0011	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0933	0.0933	0.0933	0.0933	0.0933	0.0933
Transmission	2.8637	0.8438	0.0208	2.7656	0.6268	0.4429
Distribution Substation	1.5599	0.0718	0.0000	0.2832	0.3005	0.2672
Total	21.8435	8.8936	2.1874	6.6557	4.1470	3.0022
<b>Seasonal</b>	7.5735			3.9005		
<b>Annual</b>	5.1282					
<b>Primary</b>						
Energy	4.0304	3.0466	2.0113	3.3635	3.0036	2.1195
Generation Capacity	12.5788	4.5307	0.0010	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0912	0.0912	0.0912	0.0912	0.0912	0.0912
Transmission	2.7423	0.8080	0.0199	2.6264	0.5939	0.4175
Distribution Substation	1.5169	0.0698	0.0000	0.2754	0.2923	0.2598
Total	20.9597	8.5464	2.1235	6.3567	3.9811	2.8880
<b>Seasonal</b>	7.2840			3.7434		
<b>Annual</b>	4.9268					
<b>Transmission</b>						
Energy	3.7820	2.8737	1.9123	3.1284	2.8095	1.9930
Generation Capacity	11.6958	4.2159	0.0010	0.0001	0.0000	0.0000
Regulation and Op. Reserves	0.0875	0.0875	0.0875	0.0875	0.0875	0.0875
Transmission	2.5513	0.7518	0.0185	2.4125	0.5438	0.3790
Distribution Substation						
Total	18.1167	7.9290	2.0193	5.6285	3.4408	2.4596
<b>Seasonal</b>	6.5471			3.2340		
<b>Annual</b>	4.3414					



**Table A.1.17. Year 2018 Summary of Time-differentiated Marginal Capacity Costs (\$ per kW) and Marginal Energy costs (\$ per kWh)**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Secondary</b>						
Monthly Costs per Kilowatt (2018 Dollars per Kilowatt)						
Generation Capacity	\$0.737	\$0.416	\$0.000	\$0.000	\$0.000	\$0.000
Transmission	\$3.901	\$1.800	\$0.086	\$2.501	\$1.927	\$1.602
Distribution Substation	\$1.884	\$0.136	\$0.000	\$0.227	\$0.819	\$0.857
<b>Total</b>	\$6.521	\$2.352	\$0.086	\$2.728	\$2.746	\$2.459
<b>Seasonal</b>	\$8.959			\$7.933		
<b>Annual</b>	\$8.275					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	4.0764	3.0868	2.0284	3.4847	3.1027	2.2068
Regulation and Op. Reserves	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862
<b>Total</b>	\$4.163	\$3.173	\$2.115	\$3.571	\$3.189	\$2.293
<b>Seasonal</b>	\$2.776			\$2.808		
<b>Annual</b>	\$2.797					
<b>Primary</b>						
Monthly Costs per Kilowatt (2018 Dollars per Kilowatt)						
Generation Capacity	\$0.705	\$0.398	\$0.000	\$0.000	\$0.000	\$0.000
Transmission	\$3.735	\$1.724	\$0.082	\$2.375	\$1.826	\$1.510
Distribution Substation	\$1.832	\$0.132	\$0.000	\$0.221	\$0.797	\$0.833
<b>Total</b>	\$6.272	\$2.254	\$0.083	\$2.596	\$2.623	\$2.343
<b>Seasonal</b>	\$8.609			\$7.562		
<b>Annual</b>	\$7.911					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.9250	2.9819	1.9690	3.3363	2.9811	2.1270
Regulation and Op. Reserves	0.0843	0.0843	0.0843	0.0843	0.0843	0.0843
<b>Total</b>	4.0093	3.0662	2.0533	3.4206	3.0654	2.2113
<b>Seasonal</b>	2.6860			2.7010		
<b>Annual</b>	2.6960					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2018 Dollars per Kilowatt)						
Generation Capacity	\$0.656	\$0.370	\$0.000	\$0.000	\$0.000	\$0.000
Transmission	\$3.475	\$1.604	\$0.076	\$2.182	\$1.672	\$1.371
Distribution Substation						
<b>Total</b>	\$4.131	\$1.975	\$0.077	\$2.182	\$1.672	\$1.371
<b>Seasonal</b>	\$6.182			\$5.225		
<b>Annual</b>	\$5.544					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.6837	2.8131	1.8723	3.1035	2.7887	1.9999
Regulation and Op. Reserves	0.0809	0.0809	0.0809	0.0809	0.0809	0.0809
<b>Total</b>	3.7646	2.8939	1.9532	3.1844	2.8695	2.0808
<b>Seasonal</b>	2.5398			2.5314		
<b>Annual</b>	2.5342					



**Table A.1.18. Year 2019 Summary of Time-differentiated Marginal Capacity Costs (\$ per kW) and Marginal Energy costs (\$ per kWh)**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Secondary</b>						
Monthly Costs per Kilowatt (2019 Dollars per Kilowatt)						
Generation Capacity	\$1.635	\$0.922	\$0.000	\$0.000	\$0.000	\$0.000
Transmission	\$3.869	\$1.786	\$0.085	\$2.481	\$1.912	\$1.589
Distribution Substation	\$1.921	\$0.138	\$0.000	\$0.232	\$0.836	\$0.874
<b>Total</b>	\$7.426	\$2.847	\$0.086	\$2.713	\$2.747	\$2.463
<b>Seasonal</b>	\$10.358			\$7.923		
<b>Annual</b>	\$8.735					
Costs per kWh (2019 Cents per kWh)						
Energy Costs	4.1340	3.1649	2.1159	3.4464	3.0612	2.1393
Regulation and Op. Reserves	0.0880	0.0880	0.0880	0.0880	0.0880	0.0880
<b>Total</b>	4.2220	3.2529	2.2039	3.5344	3.1491	2.2273
<b>Seasonal</b>	2.8577			2.7560		
<b>Annual</b>	2.7900					
<b>Primary</b>						
Monthly Costs per Kilowatt (2019 Dollars per Kilowatt)						
Generation Capacity	\$1.565	\$0.883	\$0.000	\$0.000	\$0.000	\$0.000
Transmission	\$3.705	\$1.710	\$0.082	\$2.356	\$1.812	\$1.498
Distribution Substation	\$1.868	\$0.135	\$0.000	\$0.225	\$0.813	\$0.850
<b>Total</b>	\$7.139	\$2.728	\$0.082	\$2.581	\$2.624	\$2.348
<b>Seasonal</b>	\$9.949			\$7.553		
<b>Annual</b>	\$8.352					
Costs per kWh (2019 Cents per kWh)						
Energy Costs	3.9803	3.0572	2.0540	3.2991	2.9408	2.0621
Regulation and Op. Reserves	0.0860	0.0860	0.0860	0.0860	0.0860	0.0860
<b>Total</b>	4.0662	3.1432	2.1400	3.3851	3.0268	2.1481
<b>Seasonal</b>	2.7646			2.6510		
<b>Annual</b>	2.6890					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2019 Dollars per Kilowatt)						
Generation Capacity	\$1.455	\$0.822	\$0.000	\$0.000	\$0.000	\$0.000
Transmission	\$3.447	\$1.591	\$0.076	\$2.164	\$1.659	\$1.360
Distribution Substation						
<b>Total</b>	\$4.902	\$2.413	\$0.076	\$2.164	\$1.659	\$1.360
<b>Seasonal</b>	\$7.392			\$5.183		
<b>Annual</b>	\$5.919					
Costs per kWh (2019 Cents per kWh)						
Energy Costs	3.7352	2.8840	1.9532	3.0682	2.7504	1.9390
Regulation and Op. Reserves	0.0825	0.0825	0.0825	0.0825	0.0825	0.0825
<b>Total</b>	3.8177	2.9664	2.0357	3.1507	2.8328	2.0215
<b>Seasonal</b>	2.6143			2.4843		
<b>Annual</b>	2.5278					



**Table A.1.19. Year 2020 Summary of Time-differentiated Marginal Capacity Costs (\$ per kW) and Marginal Energy costs (\$ per kWh)**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Secondary</b>						
Monthly Costs per Kilowatt (2020 Dollars per Kilowatt)						
Generation Capacity	\$6.637	\$3.743	\$0.002	\$0.000	\$0.000	\$0.000
Transmission	\$3.807	\$1.757	\$0.084	\$2.441	\$1.881	\$1.563
Distribution Substation	\$1.960	\$0.141	\$0.000	\$0.236	\$0.852	\$0.891
<b>Total</b>	\$12.403	\$5.642	\$0.086	\$2.677	\$2.733	\$2.455
<b>Seasonal</b>	\$18.130			\$7.865		
<b>Annual</b>	\$11.287					
Costs per kWh (2020 Cents per kWh)						
Energy Costs	4.0918	3.0962	2.0344	3.4678	3.0818	2.1591
Regulation and Op. Reserves	0.0897	0.0897	0.0897	0.0897	0.0897	0.0897
<b>Total</b>	4.1815	3.1859	2.1241	3.5575	3.1715	2.2488
<b>Seasonal</b>	2.7886			2.7781		
<b>Annual</b>	2.7816					
<b>Primary</b>						
Monthly Costs per Kilowatt (2020 Dollars per Kilowatt)						
Generation Capacity	\$6.353	\$3.585	\$0.002	\$0.000	\$0.000	\$0.000
Transmission	\$3.645	\$1.683	\$0.080	\$2.318	\$1.782	\$1.474
Distribution Substation	\$1.906	\$0.137	\$0.000	\$0.230	\$0.829	\$0.867
<b>Total</b>	\$11.904	\$5.405	\$0.082	\$2.548	\$2.611	\$2.341
<b>Seasonal</b>	\$17.391			\$7.499		
<b>Annual</b>	\$10.797					
Costs per kWh (2020 Cents per kWh)						
Energy Costs	3.9395	2.9907	1.9747	3.3197	2.9608	2.0813
Regulation and Op. Reserves	0.0877	0.0877	0.0877	0.0877	0.0877	0.0877
<b>Total</b>	4.0272	3.0784	2.0624	3.4074	3.0485	2.1690
<b>Seasonal</b>	2.6975			2.6724		
<b>Annual</b>	2.6808					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2020 Dollars per Kilowatt)						
Generation Capacity	\$5.907	\$3.336	\$0.001	\$0.000	\$0.000	\$0.000
Transmission	\$3.391	\$1.566	\$0.075	\$2.129	\$1.632	\$1.338
Distribution Substation						
<b>Total</b>	\$9.298	\$4.902	\$0.076	\$2.129	\$1.632	\$1.338
<b>Seasonal</b>	\$14.276			\$5.099		
<b>Annual</b>	\$8.158					
Costs per kWh (2020 Cents per kWh)						
Energy Costs	3.6968	2.8211	1.8776	3.0875	2.7693	1.9573
Regulation and Op. Reserves	0.0841	0.0841	0.0841	0.0841	0.0841	0.0841
<b>Total</b>	3.7809	2.9052	1.9617	3.1716	2.8535	2.0414
<b>Seasonal</b>	2.5506			2.5046		
<b>Annual</b>	2.5200					





**Table A.1.20. Year 2021 Summary of Time-differentiated Marginal Capacity Costs (\$ per kW)  
 and Marginal Energy costs (\$ per kWh)**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Secondary</b>						
Monthly Costs per Kilowatt (2021 Dollars per Kilowatt)						
Generation Capacity	\$12.121	\$6.837	\$0.003	\$0.000	\$0.000	\$0.000
Transmission	\$3.759	\$1.735	\$0.083	\$2.410	\$1.857	\$1.544
Distribution Substation	\$1.999	\$0.144	\$0.000	\$0.241	\$0.869	\$0.909
<b>Total</b>	\$17.879	\$8.716	\$0.086	\$2.651	\$2.726	\$2.453
<b>Seasonal</b>	\$26.681			\$7.831		
<b>Annual</b>	\$14.114					
Costs per kWh (2021 Cents per kWh)						
Energy Costs	4.1994	3.1529	2.0633	3.5294	3.1379	2.1789
Regulation and Op. Reserves	0.0915	0.0915	0.0915	0.0915	0.0915	0.0915
<b>Total</b>	4.2909	3.2444	2.1548	3.6209	3.2294	2.2704
<b>Seasonal</b>	2.8411			2.8194		
<b>Annual</b>	2.8266					
<b>Primary</b>						
Monthly Costs per Kilowatt (2021 Dollars per Kilowatt)						
Generation Capacity	\$11.603	\$6.548	\$0.003	\$0.000	\$0.000	\$0.000
Transmission	\$3.599	\$1.662	\$0.000	\$2.289	\$1.760	\$1.455
Distribution Substation	\$1.944	\$0.140	\$0.000	\$0.234	\$0.845	\$0.884
<b>Total</b>	\$17.147	\$8.349	\$0.003	\$2.523	\$2.605	\$2.339
<b>Seasonal</b>	\$25.499			\$7.468		
<b>Annual</b>	\$13.478					
Costs per kWh (2021 Cents per kWh)						
Energy Costs	4.0431	3.0454	2.0027	3.3788	3.0148	2.1003
Regulation and Op. Reserves	0.0894	0.0894	0.0894	0.0894	0.0894	0.0894
<b>Total</b>	4.1326	3.1348	2.0921	3.4683	3.1042	2.1897
<b>Seasonal</b>	2.7482			2.7121		
<b>Annual</b>	2.7242					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2021 Dollars per Kilowatt)						
Generation Capacity	\$10.789	\$6.093	\$0.003	\$0.000	\$0.000	\$0.000
Transmission	\$3.349	\$1.546	\$0.074	\$2.102	\$1.611	\$1.321
Distribution Substation						
<b>Total</b>	\$14.138	\$7.639	\$0.076	\$2.102	\$1.611	\$1.321
<b>Seasonal</b>	\$21.853			\$5.035		
<b>Annual</b>	\$10.641					
Costs per kWh (2021 Cents per kWh)						
Energy Costs	3.7940	2.8726	1.9040	3.1427	2.8199	1.9750
Regulation and Op. Reserves	0.0858	0.0858	0.0858	0.0858	0.0858	0.0858
<b>Total</b>	3.8798	2.9584	1.9898	3.2285	2.9057	2.0608
<b>Seasonal</b>	2.5983			2.5418		
<b>Annual</b>	2.5607					



**Table A.1.21. Year 2022 Summary of Time-differentiated Marginal Capacity Costs (\$ per kW) and Marginal Energy costs (\$ per kWh)**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Secondary</b>						
Monthly Costs per Kilowatt (2022 Dollars per Kilowatt)						
Generation Capacity	\$17.176	\$9.688	\$0.004	\$0.000	\$0.000	\$0.000
Transmission	\$3.743	\$1.728	\$0.082	\$2.400	\$1.849	\$1.537
Distribution Substation	\$2.039	\$0.147	\$0.000	\$0.246	\$0.887	\$0.927
<b>Total</b>	\$22.958	\$11.563	\$0.087	\$2.646	\$2.736	\$2.465
<b>Seasonal</b>	\$34.608			\$7.847		
<b>Annual</b>	\$16.767					
Costs per kWh (2022 Cents per kWh)						
Energy Costs	4.1863	3.1541	2.0721	3.5135	3.1264	2.1988
Regulation and Op. Reserves	0.0933	0.0933	0.0933	0.0933	0.0933	0.0933
<b>Total</b>	4.2796	3.2475	2.1655	3.6068	3.2197	2.2921
<b>Seasonal</b>	2.8457			2.8241		
<b>Annual</b>	2.8313					
<b>Primary</b>						
Monthly Costs per Kilowatt (2022 Dollars per Kilowatt)						
Generation Capacity	\$16.442	\$9.278	\$0.004	\$0.000	\$0.000	\$0.000
Transmission	\$3.585	\$1.655	\$0.079	\$2.279	\$1.753	\$1.449
Distribution Substation	\$1.983	\$0.143	\$0.000	\$0.239	\$0.862	\$0.902
<b>Total</b>	\$22.010	\$11.076	\$0.083	\$2.518	\$2.615	\$2.351
<b>Seasonal</b>	\$33.169			\$7.484		
<b>Annual</b>	\$16.046					
Costs per kWh (2022 Cents per kWh)						
Energy Costs	4.0304	3.0466	2.0113	3.3635	3.0036	2.1195
Regulation and Op. Reserves	0.0912	0.0912	0.0912	0.0912	0.0912	0.0912
<b>Total</b>	4.1217	3.1379	2.1025	3.4547	3.0949	2.2107
<b>Seasonal</b>	2.7527			2.7167		
<b>Annual</b>	2.7287					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2022 Dollars per Kilowatt)						
Generation Capacity	\$15.288	\$8.634	\$0.004	\$0.000	\$0.000	\$0.000
Transmission	\$3.335	\$1.540	\$0.073	\$2.094	\$1.605	\$1.316
Distribution Substation						
<b>Total</b>	\$18.623	\$10.173	\$0.077	\$2.094	\$1.605	\$1.316
<b>Seasonal</b>	\$28.873			\$5.014		
<b>Annual</b>	\$12.967					
Costs per kWh (2022 Cents per kWh)						
Energy Costs	3.7820	2.8737	1.9123	3.1284	2.8095	1.9930
Regulation and Op. Reserves	0.0875	0.0875	0.0875	0.0875	0.0875	0.0875
<b>Total</b>	3.8696	2.9613	1.9998	3.2159	2.8970	2.0805
<b>Seasonal</b>	2.6027			2.5462		
<b>Annual</b>	2.5651					



## APPENDIX 2: HYPOTHETICAL SEASONAL ALLOCATION OF MARGINAL CAPACITY COST

OTP wanted to test a hypothetical scenario where the marginal cost of generation capacity would have shifted to the winter season by about 30% to test the sensitivity of overall seasonal costs to changes in the capacity cost allocation.<sup>9</sup> The resulting per-kWh cost estimates under this hypothetical scenario, averaged for years 2018 through 2022 and stated in 2018\$, are shown in Table A.2.1. The marginal per-kW costs are shown in Table A.2.2.

**Table A.2.1. Average 2018 – 2022 Marginal Time-Differentiated Costs per kWh assuming a 70/30 generation capacity cost split for Winter and Summer**

	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Average 2018-2022</b>	----- (2018 Cents per kWh) -----					
<b>Secondary</b>						
Energy	3.9774	3.0101	1.9834	3.3537	2.9822	2.0928
Generation Capacity	3.8567	1.3885	0.0003	1.4050	0.0714	0.0748
Op. Reserves	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862
Transmission	2.8081	0.8274	0.0204	2.7119	0.6146	0.4343
Distribution Substation	1.4411	0.0663	0.0000	0.2617	0.2777	0.2468
Total	12.1695	5.3785	2.0903	7.8185	4.0321	2.9350
<b>Seasonal</b>	4.8101			3.9604		
<b>Annual</b>	4.2444					
<b>Primary</b>						
Energy	3.8294	2.9076	1.9252	3.2106	2.8652	2.0173
Generation Capacity	3.6919	1.3298	0.0003	1.3448	0.0685	0.0716
Regulation and Op. Reserves	0.0843	0.0843	0.0843	0.0843	0.0843	0.0843
Transmission	2.6891	0.7923	0.0157	2.5754	0.5824	0.4094
Distribution Substation	1.4014	0.0645	0.0000	0.2545	0.2700	0.2400
Total	11.6962	5.1785	2.0256	7.4695	3.8704	2.8225
<b>Seasonal</b>	4.6346			3.7999		
<b>Annual</b>	4.0789					
<b>Transmission</b>						
Energy	3.5936	2.7428	1.8306	2.9861	2.6800	1.8969
Generation Capacity	3.4328	1.2374	0.0003	1.2501	0.0640	0.0665
Regulation and Op. Reserves	0.0809	0.0809	0.0809	0.0809	0.0809	0.0809
Transmission	2.0289	0.6048	0.0246	1.9190	0.4402	0.3098
Distribution Substation	0.6035	0.1778	0.0044	0.5707	0.1286	0.0897
Total	9.7397	4.8437	1.9406	6.8068	3.3937	2.4438
<b>Seasonal</b>	4.1455			3.3477		
<b>Annual</b>	3.6143					

<sup>9</sup> In recent years, MISO has discussed setting planning capacity requirements on a seasonal basis, yet, to date no specific plan has been proposed and not enough information to analyze the potential seasonal results is available.



**Table A.2.2. Average 2018 – 2022 Marginal Time-Differentiated per-kW Capacity Costs with 70/30 generation capacity cost split for Winter and Summer and Energy per-kWh Costs**

Average 2018-2022	Summer Season			Winter Season		
	Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
<b>Secondary</b>						
Monthly Costs per Kilowatt (2018 Dollars per kW)						
Generation Capacity	\$5.041	\$2.843	\$0.001	\$1.219	\$0.211	\$0.260
Transmission	\$3.671	\$1.694	\$0.081	\$2.354	\$1.813	\$1.508
Distribution Substation	\$1.884	\$0.136	\$0.000	\$0.227	\$0.819	\$0.857
<b>Total</b>	\$10.596	\$4.673	\$0.082	\$3.800	\$2.843	\$2.624
<b>Seasonal</b>	\$15.351			\$9.268		
<b>Annual</b>	\$11.296					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.9774	3.0101	1.9834	3.3537	2.9822	2.0928
Regulation and Op. Reserves	0.0862	0.0862	0.0862	0.0862	0.0862	0.0862
<b>Total</b>	4.0636	3.0964	2.0696	3.4399	3.0685	2.1790
<b>Seasonal</b>	2.7129			2.6891		
<b>Annual</b>	2.6971					
<b>Primary</b>						
Monthly Costs per Kilowatt (2018 Dollars per kW)						
Generation Capacity	\$4.826	\$2.723	\$0.001	\$1.167	\$0.202	\$0.249
Transmission	\$3.515	\$1.623	\$0.062	\$2.235	\$1.718	\$1.421
Distribution Substation	\$1.832	\$0.132	\$0.000	\$0.221	\$0.797	\$0.833
<b>Total</b>	\$10.173	\$4.478	\$0.064	\$3.623	\$2.717	\$2.503
<b>Seasonal</b>	\$14.714			\$8.843		
<b>Annual</b>	\$10.800					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.8294	2.9076	1.9252	3.2106	2.8652	2.0173
Regulation and Op. Reserves	0.0843	0.0843	0.0843	0.0843	0.0843	0.0843
<b>Total</b>	3.9137	2.9919	2.0095	3.2949	2.9494	2.1016
<b>Seasonal</b>	2.6244			2.5868		
<b>Annual</b>	2.5994					
<b>Transmission</b>						
Monthly Costs per Kilowatt (2018 Dollars per kW)						
Generation Capacity	\$4.487	\$2.534	\$0.001	\$1.085	\$0.189	\$0.231
Transmission	\$2.652	\$1.239	\$0.097	\$1.665	\$1.299	\$1.076
<b>Total</b>	\$7.139	\$3.773	\$0.098	\$2.750	\$1.488	\$1.307
<b>Seasonal</b>	\$11.010			\$5.545		
<b>Annual</b>	\$7.367					
Costs per kWh (2018 Cents per kWh)						
Energy Costs	3.5936	2.7428	1.8306	2.9861	2.6800	1.8969
Regulation and Op. Reserves	0.0809	0.0809	0.0809	0.0809	0.0809	0.0809
<b>Total</b>	3.6745	2.8236	1.9114	3.0670	2.7608	1.9778
<b>Seasonal</b>	2.4815			2.4244		
<b>Annual</b>	2.4435					