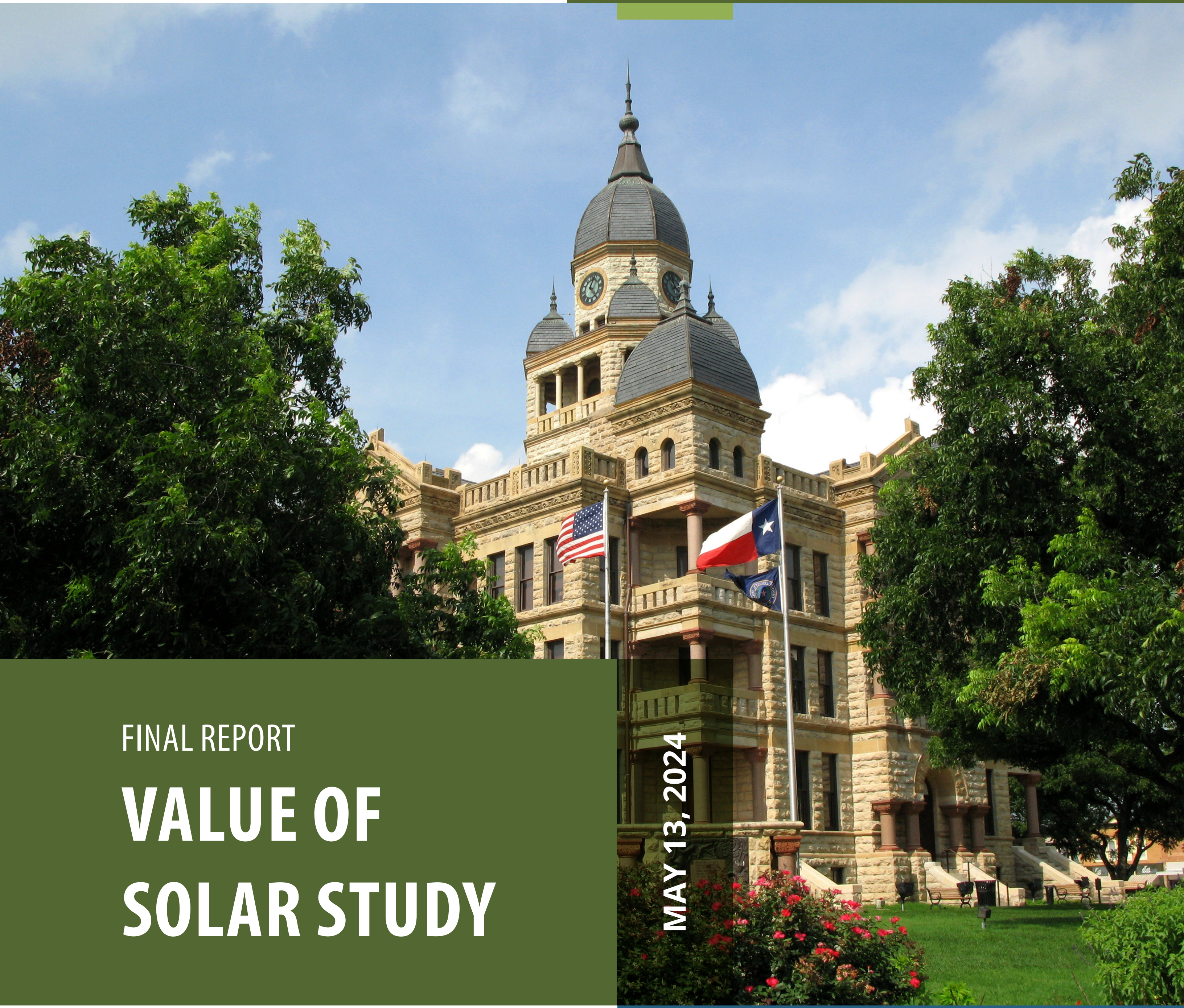
NewGen Strategies & Solutions

www.newgenstrategies.net



FINAL REPORT

VALUE OF SOLAR STUDY

MAY 13, 2024

DENTON MUNICIPAL ELECTRIC

Prepared for:
Denton Municipal Electric

Table of Contents

List of Tables

List of Figures

Section 1
INTRODUCTION, BACKGROUND, AND METHODOLOGY

Introduction

Denton Municipal Electric (DME) retained NewGen Strategies and Solutions, LLC (NewGen) to develop a Value of Solar (VOS) Study (Study) in November 2023. The goal of this Study is to provide a rate ($/kilowatt-hour [kWh]) to compensate DME customers who have installed solar distributed generation (solar DG) for surplus energy pushed into the DME distribution system. There are a variety of ways to calculate a compensation rate for customers who sell energy back to DME. Customers can be compensated at the current retail rate, an Avoided Cost rate, or a VOS rate. This report (Report) develops the VOS method, which includes the Avoided Cost rate. The Avoided Cost rate was calculated using the costs that DME avoids by not having to generate or purchase an additional kWh to serve load. The VOS rate ($/kWh) was determined based on three primary components: Avoided Cost, Societal Benefits, and Policy Driven Incentives.

In the industry, the VOS rate compensation method is generally paired with the Buy-All Sell-All billing and metering setup. The Buy-All Sell-All metering setup requires two meters: one meter registers all the energy generated by the customer's solar DG facility and the second meter measures all the energy that the customer consumes. The customer is billed at the standard residential tariff rate for all the power they use. The customer is compensated for the energy generated from their solar DG facility at the VOS rate. Customers served by a Buy-All Sell-All program do not consume the energy produced by their solar DG facility. The Buy-All Sell-All program has been used by Austin Energy since 2012 and is currently being considered for use by the City of Georgetown.

Current DME solar DG customers have one bidirectional meter and cannot be billed under a Buy-All Sell All program. DME has over 1,100 solar DG customers and a Buy-All Sell-All program would require a second meter at each customer's site. This Report summarizes our analyses with respect to the development of an Avoided Cost rate to be used with a bidirectional program and a VOS rate to be used with a Buy-All Sell-All program (which would require installation of second meters for all solar DG customers) for the City of Denton, Texas (City) and DME.

DME Description

DME is an enterprise of the City providing electricity to customers within and outside the boundaries of the City. DME operates the utility with oversight by the Denton City Council (the City Council), which is advised by the Public Utility Board (PUB). The City Council retains authority for approval of the annual budget, rates for electric service, eminent domain, and approval of debt issuances.

DME serves approximately 64,000 retail electric customers in northwest Texas and delivers around 1.6 billion kWh annually. DME operates their own transmission and distribution system which encompasses 33 miles of transmission lines and 950 miles of overhead and underground distribution lines. The City passed Resolution No. 18-085 in 2018 requiring DME to serve customers using 100% renewable energy. Since 2021, DME has served their customer energy needs with 100% renewable power through solar and wind Purchase Power Agreements (PPAs) and Renewable Energy Credits (RECs).

DME also owns and operates the Denton Energy Center (DEC). The DEC is a natural gas plant with quick start reciprocating engines that can be called upon when needed. The DEC helps provide DME with a revenue stream to offset power costs when energy demand and prices suddenly change. The DEC has the flexibility to produce energy at different levels while supporting DME's renewable power purchase portfolio.

DME currently has approximately 1,100 residential customers and 25 commercial customers with solar DG that contribute approximately 10.7 million kWh annually (less than 1% of DME's load).

Background

Solar DG refers to the generation of electricity from solar photovoltaic (PV) systems installed on or near the site where the electricity is consumed, such as rooftops of residential or commercial buildings. This approach to electricity generation gives customers the opportunity to reduce their electricity bills while also contributing to environmental sustainability by reducing their carbon footprint and reliance on fossil fuels. The next few paragraphs provide a summary of solar DG metering options and energy outflow compensation options.

Solar DG Metering and Billing Options in the Industry

The three most common ways to meter solar DG customers' inflow and outflow are Traditional Net Energy Metering (NEM), Net Billing, and Buy-All Sell-All metering. Descriptions of each method are provided below along with a summary in Table 1-1, and billing examples can be found in Appendix A in Tables A-1 and A-3.

Traditional Net Energy Metering

Net Energy Metering (NEM) is the most common compensation mechanism used by utilities. Under NEM, the utility meters the net of the electricity generated by the customer's solar DG system and the electricity consumed from the grid. The metering may be as simple as one meter with one dial that runs forward and backward.

Most often, the term NEM refers to the monthly netting of energy inflow and outflow. When the solar system produces more electricity than the customer consumes, the excess electricity is exported to the utility grid and the customer receives kWh credits for the excess energy generated. These credits can be used to offset future energy use. Often, the customer receives full retail credit for the outflow. In net metering, the utility is operating as a virtual bank for the solar DG customer by allowing the customer to generate during daylight hours and send power to the grid, but then use power any time they need it, often after the sun sets. The customer receives the benefit of using their generation to offset their usage at any time.

Net Billing

This metering method measures the inflow and outflow instantaneously or at specific time intervals (5 minutes, 15 minutes, hourly, etc.).[1] Net Billing allows the utility to track the actual energy provided to the

[1] https://www.nrel.gov/state-local-tribal/energy-compensation-mechanisms.html#:~:text=In%20net%20billing%2C%20DG%20system,consumption%20to%20the%20utility%20grid.

customer and the actual energy provided to the utility. Often, the customer is credited for the outflow based on the utility's Avoided Cost.

Buy-All Sell-All

Buy-All Sell-All is a metering and billing method or program in which the customer is served power under their applicable class tariff as recorded by a consumption meter. The production from the customer's solar DG facility is metered separately and 100% of the power is sold to the utility. The customer pays the full applicable retail rate for any energy usage and is credited an Avoided Cost rate, VOS rate, or other approved rate for all sales to the utility. In any hour, the customer can have both sales of energy and purchases of energy. The "netting" occurs on a dollar basis on the customer's monthly bill (customer's total bill for power less credit for energy sent to the utility).

Buy-All Sell-All requires either the addition of an export validation meter to a bidirectional meter or the use of two unidirectional meters. This is required for the utility to accurately track both the customer's usage and generation separately, unlike the net usage tracked in NEM.

Table 1-1
Industry Solar DG Metering Options

	Traditional Net Metering (Monthly Netting)	Net Billing	Buy-All Sell-All (No Energy Netting)
No. of Meters	1 net meter	1 two-channel bidirectional meter	2 meters
Netting Frequency	Billing cycle	Instantaneously	Not applicable
Self-Consumption Allowed	Yes	Yes	No
Solar DG Customer Purchases Inflow	Retail rate	Retail rate	Retail rate
Outflow Compensation to Customer	Retail rate	Avoided Cost	Value of Solar, Avoided Cost
Credits Carry Forward	Varies	Varies	Not applicable
Credits Recorded In	Energy (kWh)	Dollars	Not applicable
Credits Expire	Varies	Varies	Not applicable

Outflow Compensation Options

Utilities compensate customers for energy sent back to the utility (outflow) using primarily three types of rates which include the retail rate, Avoided Cost rate, or a VOS rate.

Retail Rate

For the retail rate, NEM customers receive a credit in kWh rather than a dollar-based credit for their outflow. While some utilities allow these kWh credits to offset future energy consumption, effectively compensating customers at the full retail rate, other utilities may not permit such credit applications towards future bills.

Avoided Cost

The "Avoided Cost" is the cost to the utility of the electric energy avoided due to the purchase of energy from the customer's solar DG facility. The Avoided Cost rate may include energy or energy and capacity. The calculation of the Avoided Cost rate varies from state to state and there are multiple ways to calculate the Avoided Cost. The Avoided Cost calculation should also account for lower system losses. Because the customer is generating power where the power is consumed, there are no transmission or distribution line losses. Background information regarding the development of an Avoided Cost methodology for DME is further described in Section 2.

Value of Solar (VOS)

Energy purchased from a solar DG customer may be valued at a rate that is greater than the traditional Avoided Cost rate depending on the utility's policies. The utility may support or encourage renewable energy and therefore place a higher value on renewable energy related to various benefits that can be defined as Societal Benefits (including cleaner air and general public welfare concerns) as well as Policy Driven Incentives (costs intended to further the city's or utility's renewable energy goals). The rate resulting from these considerations is referred to as a Value of Solar rate.

Subsidization of Solar Customers

A major concern with the metering and billing of solar DG customers is the level of subsidization that may exist. Depending on rate structure and rate levels, customers with solar DG facilities are subsidized by customers without solar DG. This has been acknowledged by the National Association of Regulatory Utility Commissioners (NARUC), by the American Public Power Association (APPA), and by multiple public utility commissions.

NARUC states in its Distributed Energy Resources Rate Design and Compensation publication that:

> *However, DER customers who supply most, if not all, of their own needs annually, but not necessarily daily, may be undercompensating the utility under certain NEM rate designs for the generation, transmission, and distribution investments that were made on behalf of the DER customer. Under such a situation, it is difficult to design a single rate that is appropriate for all customers in an existing rate class, as non-DER customers end up subsidizing DER customers. The solution would be to design rates that recover from DER customers an appropriate amount to compensate the utility for the investments it has made.*[2]

APPA states in its Rate Design for Distributed Generation publication that:

> *Most utilities in the U.S. use net metering to measure and compensate customers for the generation they produce. However net metering has several shortcomings and results in non-DG customers subsidizing DG customers.*
>
> *As more customers install DG systems, the cost-revenue disparity grows wider, leading to even more cross subsidization.*
>
> *Net metering causes revenue shortfalls for utilities, and creates a situation where one class of customers is subsidizing another. In the long run, this is untenable, especially as more customers*

[2] https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0

> *install DG systems. Utilities should consider modified approaches to net metering, or completely new billing arrangements . . .*[3]

APPA[4] states in its Value of the Grid publication[5] that:

> *Net energy metering (NEM), the most common rate design for DG customers, creates subsidies between customers in the same class. This is because though a high proportion of a utility's costs are fixed, however, 90 percent or more of utility revenue is normally recovered through variable charges. Therefore, the recovery of fixed costs through variable charges creates an imbalance where net metered customers are compensated (or credited) for their excess generation at retail rates, and non-DG customers pay a greater share of the cost through the variable charges.*

California Public Utilities Commission

The California Public Utilities Commission's (CPUC) net metering policy, NEM 3.0, was updated to reduce the amount that customers without solar DG pay to support customer with solar DG. The CPUC altered the rates because paying solar DG owners near-retail prices allows these mostly wealthy property owners to avoid paying their fair share to maintain the grid, potentially burdening other consumers with higher electric bills, including low-income customers.[6] The CPUC stated the following in the proposed decision on this topic:

> *Affordability is front and center in this proceeding, given the finding that a significant and growing cost shift exists in the previous tariff and, to a lesser extent, remains in the adopted successor tariff. This cost shift is created by the ability of distributed generation customers to avoid fixed costs, including grid costs and public purpose program costs, which then become the responsibility of non-participating ratepayers, including low-income customers. The successor tariff adopted in this decision is designed to compensate customers for the value of their exports to the grid based on the Avoided Cost Calculator. This improved valuation will significantly reduce the cost shift and improve affordability for nonparticipating ratepayers, particularly low-income ratepayers. The subsidization of solar DG customers by non-solar DG customers can occur in many ways, including rate design, rate levels, rebates, and incentives.* [7]

Subsidization from Rate Structure and Rate Design

Subsidization primarily and most commonly results from the standard tariff's rate structure and rate levels. The source of these subsidies can be traced back to the utilities' need to maintain rates that generate the necessary revenues to cover their costs, especially fixed costs. Residential electric rate offerings typically include a fixed monthly charge and a variable usage charge. Fixed monthly charges are intended to recover the costs that do not change based on a utility's customers' usage, such as building and maintaining the transmission and distribution system, servicing debt, labor for accounting, customer service/billing, regulatory compliance, and administrative expenses. Variable charges are typically recovered on a $/kWh basis and include the cost of energy (fuel, purchased power, ancillary services) that changes depending on how much their customers are using.

---

[3] https://www.publicpower.org/system/files/documents/ppf_rate_design_for_dg.pdf
[4] https://www.publicpower.org/system/files/documents/ppf_rate_design_for_dg.pdf
[5] https://www.publicpower.org/system/files/documents/Value%20of%20the%20Grid_1.pdf
[6] https://calmatters.org/environment/2023/11/california-solar-payment/
https://www.utilitydive.com/news/california-puc-net-metering-policy-nem-appeals-court/702569/
[7] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M499/K921/499921246.PDF

This discrepancy arises from traditional utility billing structures that primarily utilize $/kWh rates and have been slow to implement fixed monthly charges that recover all fixed costs. This is most often seen in residential and small commercial rates as these rates usually do not include a demand charge. In our experience, the Customer Charge is consistently set too low to collect the utility's fixed costs of service. To make up for the difference, the energy charge includes recovery of the fixed and variable costs. Therefore, if a solar DG customer is given full retail credit for each kWh they generate, they are not paying their share of the fixed cost of service.

As a result of this rate design discrepancy, a utility may not fully recover its fixed costs from solar DG customers. Since solar DG customers rely less on grid-provided electricity during times of solar generation, they contribute less toward covering the fixed costs of the grid infrastructure. NARUC has been aware of this issue and suggests that utilities take a closer look at their fixed costs and fixed cost recovery methods.[8] Addressing this imbalance may require adjustments to rate structures to ensure that all customers, including solar DG customers, contribute proportionately to the fixed costs of maintaining the grid infrastructure.

Subsidization from Solar Grants and Rebates

If the utility provides grants, rebates, or incentives to support solar DG installations, these costs are often recovered from all utility customers, not just those installing the solar facilities. This results in non-solar DG customers effectively subsidizing solar DG customers, which leads to concerns about equity and fairness in cost-sharing across a utility's customer base.

DME Proposed Value of Solar Methodology

The VOS rate credit is an element of compensation provided to solar DG customers to assist the utility in achieving its renewable energy goals. However, to the extent that the VOS credit is greater than the direct economic savings to DME, the VOS credit may result in a subsidy to solar DG customers from non-solar DG customers. The appropriate basis for a VOS credit is a policy decision regarding the appropriate balance between equity (minimizing subsidy) and attainment of DME's policy objectives.

There are at least two approaches that the City and DME could employ to establish a VOS credit. One is an incentive policy (which may include consideration of subjective societal benefits and policy driven goals) and the other is a calculation of estimated cost savings (i.e., cost avoidance) to DME as a result of the generation from solar DG.

For the purposes of this Study, the proposed DME VOS rate ($/kWh) was determined based on three primary components: Avoided Cost, Societal Benefits, and Policy Driven Incentives.

[8] https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0

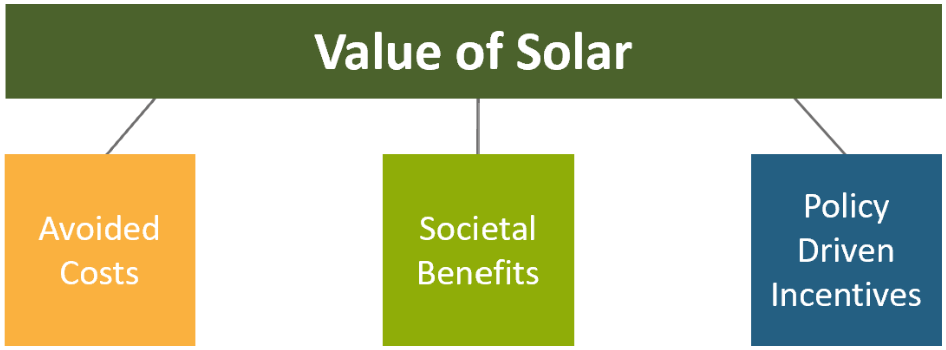


Figure 1-1. Value of Solar Components

Avoided Costs

Avoided Costs refer to the expenses that a utility or energy provider saves by not having to generate or procure electricity from traditional sources. This includes savings in energy production costs, such as fuel and operating expenses, as well as the costs avoided related to building new capacity or procuring additional PPAs to meet future power needs. Additionally, avoided losses, such as transmission and distribution losses, contribute to cost savings by reducing inefficiencies in the energy delivery process. By analyzing factors such as historic peak demand periods and fluctuating energy prices within the Electric Reliability Council of Texas (ERCOT) market, utilities can estimate the economic benefits provided by solar DG customers and optimize their financial viability. While solar DG aligns with daytime electricity demand, grid operators must balance its output with other energy sources to ensure reliable electricity supply, particularly during peak demand times.

Societal Benefits

The Societal Benefits portion of the VOS can represent the theoretical benefits to society of solar DG, including avoidance of greenhouse gases and other emissions associated with fossil fuel generation resources. It should be noted that in certain states like California, avoided emissions for pollutants with established markets (such as those for nitrous oxide [NOx] and sulfuric oxide [SOx]) are generally associated with the Avoided Cost methodology. There are a variety of methods that can be used to estimate the savings associated with the avoidance of greenhouse gases and other fossil fuel emissions. For the purposes of this Study, we have focused on greenhouse gas emissions and utilized the United States (U.S.) Federal Government methodology referred to as the Social Cost of Carbon (SCC). The SCC is an estimate of the cost to society from a ton of carbon emissions, and it is used to evaluate program benefits that reduce carbon emissions. The SCC puts the effects of climate change into economic terms to help policymakers understand how emissions-related policies affect the economy.

Whereas Avoided Costs (Section 2) are based on actual costs avoided by the utility from solar DG, the Societal Benefits of reducing carbon emissions are theoretical cost savings. In the short term, the utility does not avoid any costs or reduce expenses beyond the Avoided Cost. In the long term, there are assumed cost savings due to increased societal and environmental health, which may or may not be recognized by a utility.

Policy Driven Incentives

Cities and their utilities may have policies aimed at incentivizing solar DG. Depending on the policies, the utility may consider a credit given to solar DG customers as an incentive to encourage the adoption of solar DG. By providing incentives, such as credits or financial benefits, utilities can help offset the initial investment costs for solar DG customers, making solar energy more financially attractive and accelerating the transition to renewable energy.

Section 4 reviews the City's and DME's policies and strategies regarding the promotion of solar DG and renewable energy adoption. For the City, programs such as the GreenSense Incentive Program and the City's Renewable Resource Plan play a role in fostering a transition to renewable energy sources.

Despite DME's achievement of 100% renewable energy, ongoing initiatives like the City's Climate Action Adaptation Plan (CAAP) underscore the importance of furthering sustainable energy goals, including specific targets for installed solar DG.

Report Organization

This Report provides a comprehensive analysis of the economic impacts of solar DG and is organized into six sections. Section 2 details the calculations for Avoided Costs. Section 3 describes broader Societal Benefits associated with solar DG deployment, encompassing theoretical environmental advantages. Section 4 examines the City's and DME's various policy driven incentives surrounding renewable energy goals. Section 5 compares other utilities' approaches to valuing solar DG. Finally, Section 6 concludes by offering recommendations on how best to compensate customers with solar DG.

Our Report contains six sections as follows:

- Section 1 – Executive summary
- Section 2 – Avoided Cost methodology and calculations
- Section 3 – Societal Benefits methodology and calculations
- Section 4 – DME's policy driven incentives
- Section 5 – Benchmarking other utilities' approaches
- Section 6 – Summary of conclusions and recommendations

Section 2
VALUE OF SOLAR: AVOIDED COST RATE

This section summarizes the methodology and assumptions used to develop the DME Avoided Cost rate for solar DG. Avoided Costs refer to the expenses that a utility or energy provider saves by not having to generate or procure electricity from traditional sources. This includes savings in energy production costs, such as fuel and operating expenses, and may include Avoided Costs related to building new capacity or procuring additional PPAs to meet power needs. Avoided expenses for ERCOT ancillary and transmission services are also considered in the calculation of DME's Avoided Cost rate. Additionally, avoided losses, such as transmission and distribution losses, further contribute to DME's cost savings for solar DG by reducing inefficiencies in the energy delivery process.

Background

The Avoided Cost reflects the minimum compensation that an electric utility must provide to an independent power producer as mandated by the Public Utility Regulatory Policies Act (PURPA) regulations of 1978.[9] PURPA was enacted to promote energy conservation and encourage the use of renewable energy sources. It sought to diversify the country's energy supply and reduce dependence on fossil fuels by encouraging the development of alternative energy technologies. The generating units installed under this legislation are called Qualifying Facilities or QFs. For QFs, the compensation is equivalent to the expenses that the utility saves by not generating or procuring that power itself.

According to PURPA, electric utilities must purchase energy from QFs at their Avoided Cost rate. The Avoided Cost may include energy or energy and capacity. The calculation of the Avoided Cost rate varies from state to state and there are multiple ways to calculate the Avoided Cost. Common methods used to determine the Avoided Cost are listed below:

- Proxy unit: This method assumes that the utility is building a generating unit. The hypothetical cost of that unit is used to set the Avoided Cost. The energy Avoided Cost is based on the variable costs (fuel and operations and maintenance [O&M]) and the capacity Avoided Cost is based on the capital costs to build the generation facility.
- Peaker unit methodology: Similar to the Proxy unit method, the energy Avoided Cost is based on the forecast payments for a peaking generation unit; often a natural gas turbine is used as the type of peaking generation unit for this method.
- Differential revenue requirement: This method calculates the revenue requirement for the utility with and without the QF unit. The difference, or savings from the QF, is the Avoided Cost to be paid to the QF.
- Integrated resource plan (IRP) based Avoided Cost: This method uses the utility's or a state's IRP to determine what the next avoided generation unit will be. Similar to the above methods, the energy Avoided Cost is based on the variable costs (fuel and O&M) and the capacity Avoided Cost is based on the capital costs to build the facility.

[9] https://www.ferc.gov/media/public-utility-regulatory-policies-act-1978

- Market-based pricing: If the utility is in a wholesale competitive power market, the utility can use the market energy and/or market and capacity rates as the Avoided Cost. For DME, this would be the ERCOT Market.
- Competitive bidding: If the utility issues a request for proposals (RFP) for power, the winning bid can be considered the next avoided generating unit and used as the Avoided Cost. For DME, this would be their solar PPAs.

The Avoided Cost calculation should also account for the difference in system losses between centralized generation facilities (or ERCOT for DME) and solar DG facilities. Because the customer is generating and consuming power at the same location, the cost impacts associated with no transmission or distribution line losses are avoided.

Methodology

The Avoided Cost rate development considers the following cost categories: avoided energy-related costs (ERCOT purchased power, ERCOT ancillary services, and current solar PPA costs) and avoided capacity related costs (generation capacity, distribution capacity, and transmission capacity). As indicated above, for the purposes of this Study, avoided costs for market-based emission costs (such as for NOx and SOx) are assumed to be incorporated into the ERCOT purchased power and have not been separately calculated.

Three Avoided Cost rates were developed for this Study: two flat rates (rates that do not vary with season or time) and a representative time-of-use (TOU) rate (a rate that varies with the season and time). The TOU rate was developed to consider customers who have solar DG and on-site battery storage systems. Customers with solar DG paired with battery storage are becoming more prevalent in Texas due to a reduction in battery costs and increased customer acceptance. A customer with solar DG and battery storage can add more value to the utility by selling power back to the utility during peak periods or using their stored energy during the utility's peak operating hours, typically in the afternoon or early evening. However, solar DG with battery storage can also lead to decreases in fixed cost recovery under typical NEM rate structures. For the purposes of this Study, we have not addressed issues related to fixed cost recovery for solar DG paired with battery storage.

For DME, three Avoided Cost rates were developed based on the following criteria:

- Based on **ERCOT data:** A Flat Rate and a separate Time-of-Use Rate
  - Transmission Avoided: ERCOT data
  - Energy Avoided: ERCOT purchased power
  - Ancillary Services Avoided: ERCOT ancillary services
- Based on **DME Solar PPA data:** A Flat Rate
  - Transmission Avoided: ERCOT data
  - Energy Avoided: DME Solar PPAs
  - Ancillary Services Avoided: ERCOT ancillary services

Data Sources

For the purpose of this Study, the National Renewable Energy Laboratory (NREL) PVWatts calculator was utilized to depict average hourly and monthly generation output. PVWatts is a widely recognized tool within the electric utility industry and is used to estimate the hourly electricity production of localized solar systems in the form of solar production curves. Solar production curves serve to estimate the hourly value of solar energy utilizing ERCOT Settlement Point Prices, the reduction in a utility's contribution to the ERCOT 4-coincident peak (4CP) for estimating avoided transmission service, and the reduction in purchases of ancillary services from the ERCOT market, all of which are important factors for determining the Avoided Cost benefits of DME's system.

The PVWatts calculator incorporates Typical Metrological Year (TMY) daily weather data for a specified location to develop a comprehensive solar production curve. Additionally, PVWatts accounts for losses in the system that include the impacts of soiling, shading, snow cover, mismatch, wiring, connections, light induced degradation, nameplate rating, system age, system orientation, and operational availability.[10]

To calculate Avoided Costs for DME, we used historical ERCOT data for the period beginning October 2022 and ending September 2023 (DME's Fiscal Year 2023). This Avoided Costs methodology bases the value components on the past fiscal year as opposed to a forward-looking (marginal cost) methodology. As a result, the methodology reflects the actual, realized value of solar DG during the preceding year, which is a reasonable proxy for the Avoided Costs anticipated for the current year in which the rate is in effect.

In calculating the Avoided Cost rate, it is our opinion that utilities have the discretion to omit ERCOT market pricing data during "Energy Emergency Alert 3" events. These events are triggered when ERCOT operating reserves fall below 1,500 megawatts (MW) or when the grid's frequency level drops below 59.8 hertz (Hz) for any duration.[11] Winter Storm Uri in February 2021 is an example of such an event, in which power became scarce on the system, market prices hit the maximum price established by ERCOT, and several utilities were forced to curtail service. Notably, no similar events occurred during DME's Fiscal Year 2023; thus, for the purposes of this Study, no ERCOT market pricing data was excluded.

DME Avoided Cost Rate Data Sources

The ERCOT North Zone Nodal Price was based on the ERCOT Historical Real Time Market (RTM) Load Zone and Hub Prices obtained from ERCOT.[12] ERCOT also supplies the ancillary service prices and volumes as well as the times for the ERCOT coincident peaks. The ERCOT postage stamp rate was obtained from the relevant Public Utility Commission of Texas (PUCT) docket.[13]

All Avoided Cost components were adjusted for estimated line losses (currently assumed to be 5.1% for the DME secondary voltage system).

Generation Capacity Investment Avoided

The generation capacity investment avoided can be estimated three ways: a) avoided capital expenditures to build capacity, b) avoided capacity purchases in a capacity market, or c) avoided contract purchases that have capacity (resource adequacy). Any of these three generation capacity options may be delayed or avoided due to the energy generated by solar DG during periods of peak load.

[10] PVWatts Version 5 Manual: https://www.nrel.gov/docs/fy14osti/62641.pdf
[11] https://www.ercot.com/files/docs/2023/06/20/2023_2024%20Energy-Emergency-Alert-Overview.docx
[12] https://www.ercot.com/mp/data-products/data-product-details?id=NP4-180-ER
[13] Public Utility Commission of Texas Docket 54507.

A review of DME's power supply documents, as well as discussions with DME's power procurement staff, suggests that DME has no plans to build or operate additional generators to meet capacity needs in the near future. Therefore, there are no capital costs avoided.

ERCOT operates an energy-only wholesale electricity market. This market design pays generators only for the energy they provide to the grid with very few exceptions. The energy-only wholesale electric market is unique in the U.S. as other competitive markets typically pay generators for having capacity available in their systems.[14] Instead, this market focuses solely on incentivizing the production of electricity to meet demand in real-time. This means that while capacity remains a critical aspect of ensuring grid reliability within ERCOT, it is not directly compensated for in the same manner as capacity markets elsewhere. In ERCOT, the emphasis is placed on efficient energy production rather than capacity availability payments, making it a unique model in the U.S. energy landscape. Therefore, there are no capacity market purchases avoided.

DME's multi-year outlook focuses on procuring additional renewable PPAs across a broad geographic range. DME recently issued and is in the process of procuring new solar contracts that are within 150 miles of the Dallas-Fort Worth (DFW) area. These contracts are energy-only contracts and, therefore, there are no capacity costs avoided.

Due to the structure of ERCOT's energy-only market, the fact that DME does not plan to build/operate an additional fossil fuel resource, and as DME's ongoing procurement of new solar contracts do not contain capacity, it is our opinion that the generation capacity value component of the VOS credit should be set to zero ($0.0000/kWh).

ERCOT Performance Credit Mechanism Proposal

As indicated above, ERCOT does not have a capacity market that pays generators to ensure there will be enough power to meet peak demand. After the devastation of Winter Storm Uri, Texas lawmakers directed regulators to ensure grid reliability and increase dispatchable generation (i.e., capacity). After investigation, stakeholder comment, studies, and analyses, the Performance Credit Mechanism (PCM) proposal was developed. The PCM's intent is to ensure that during time of highest demand and low supply, load serving entities, like DME, have sufficient dispatchable generating capacity to generate performance credits equal to their system demand. Performance credits will only be awarded to dispatchable generation assets that provide energy to the ERCOT grid during the ERCOT established compliance periods. Dispatchable generation resources will have the ability to forward commit to producing more energy during the compliance periods and will be able to sell performance credits to electricity retailers for additional income.

In 2023, the PUCT voted unanimously to adopt the PCM. However, the PUCT deferred implementation until Texas lawmakers had the opportunity to review the proposal and provide guidance. In the summer of 2023, SB 2627 and HB 1500 were enacted which adjusted the proposed PCM structure. HB1500 placed a variety of restrictions on the PUCT's proposed PCM, including limiting the cost of the PCM, and included a Dispatchable Reliability Reserve Service (DRRS) requirement. The DRRS defines which generators can participate based on how fast they can be dispatched and how long they can provide power. Under these terms, renewable energy is not qualified to be a generator.

As of the date of this report, the PUCT has not yet determined how it will implement the revised PCM proposal. However, if the PUCT implements the PCM as revised, renewable generation does not qualify

[14] https://www.ercot.com/files/docs/2019/09/17/Market_Structure_OnePager_FINAL_Revised.pdf

for any type of generation capacity credit. Therefore, it is our opinion that the avoided generation capacity value for the Avoided Cost rate should be zero.

Distribution Capacity Investment Avoided

While it is common practice in the industry to value the cost savings from solar DG installations to generation and transmission expense, it is less common to value avoided capital investment costs on the distribution system.

Impacts to the distribution system from solar DG are specific to the local circuit where they exist. The presence of solar DG could potentially avoid/defer upgrade costs if the system is installed on a distribution circuit that exceeds or is near its maximum capacity rating. However, the installation of solar on a circuit with low usage could lead to reverse energy flow and ultimately to additional maintenance and/or capital expenses for the distribution system. Thus, the presence of solar installations on the system can result in avoided distribution costs or increased distribution costs.

Because DME does not dictate or encourage installation of solar based on the locational needs of their distribution system, it is difficult to determine if any incremental benefit or cost exists with the addition of customer-sited solar. Based on discussions with DME, the distribution system is relatively new and has plenty of capacity. Therefore, we recommend that no value (either positive or negative) be assigned or included for distribution impacts in DME's VOS credit.

While solar DG does contribute to local generation, it also introduces potential challenges to the distribution grid such as voltage fluctuations, reverse power flows, and increased operational complexity. These challenges may necessitate investments in grid upgrades and management solutions to ensure grid reliability and stability which can offset any benefits provided; therefore, distribution cost savings are not included in this analysis. For the purposes of this Study, we have not included a potential contribution to reductions in future (marginal) investments in transmission and distribution capacity as a result of solar DG.

Transmission Capacity Investment Avoided

DME incurs transmission expense based on their contribution to ERCOT's annual 4CP in the prior year. The actual expense incurred is DME's contribution to the ERCOT 4CP multiplied by the sum of the individual wholesale transmission service charges billed by each transmission service provider (informally referred to as the "ERCOT postage stamp rate"). For the VOS rate, the avoided transmission cost is the reduction in DME's contribution to the ERCOT 4CP due to energy produced at that time by solar DG multiplied by the ERCOT postage stamp rate. This value is based on historical solar production at the time of the ERCOT 4CP. Figure 2-1 compares characteristic summer daily generation profiles[15] against the hours when the ERCOT 4CP has historically occurred.[16]

[15] Generation profiles are provided by National Renewable Energy Laboratory PV Watts and assume a 1 kW fixed rooftop installation oriented at 180°.

[16] Historic ERCOT 4CP hours from 2012 to 2023.

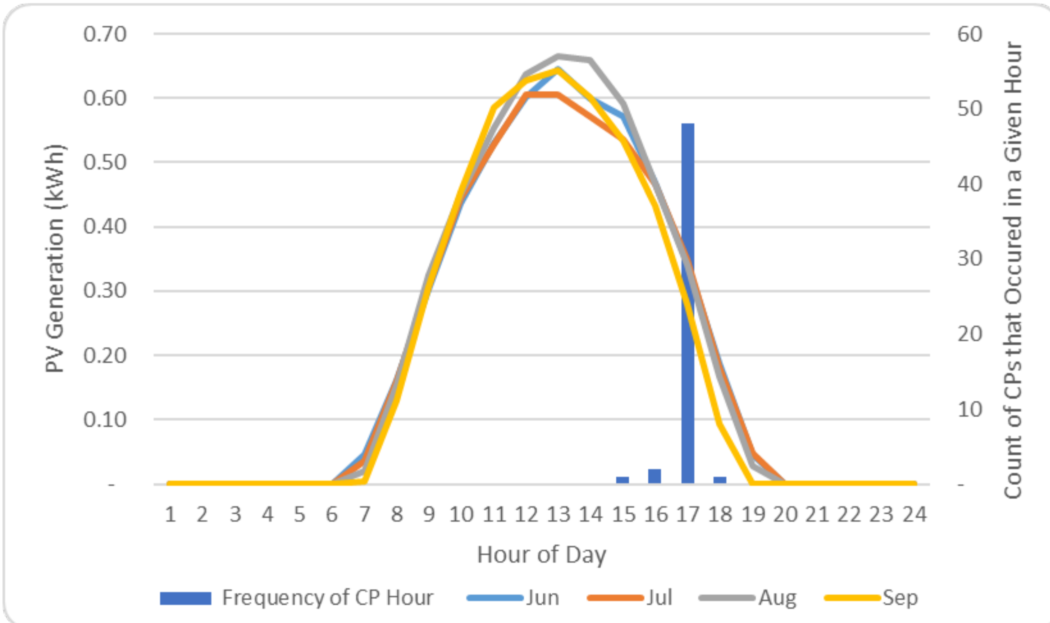


Figure 2-1. Comparison of Generation Profiles Against the Frequency of Occurrence of ERCOT 4CP Hours

As shown in Figure 2-1, the vast majority of ERCOT 4CPs occur during the summer at 5:00 p.m. when solar production is on the decline, which reduces the transmission capacity value in the Avoided Cost rate.

- **Transmission Savings** – This component is based on average solar DG during the ERCOT 4CP periods multiplied by the ERCOT postage stamp rate (the sum of the individual wholesale transmission service charges billed by each transmission service provider in ERCOT) divided by the total PV generation, as shown in this formula.

$$\textit{Transmission Savings} = \frac{\textit{Average Solar DG Generation During ERCOT 4 CP} * \textit{ERCOT Postage Stamp TCOS rate}}{\textit{Total Annual Solar DG Generation}}$$

Based on the formula above, the estimated Transmission Capacity Avoided Cost rate for DME's Fiscal Year 2023 is $0.0135/kWh, as shown in Table 2-1.

Table 2-1
Transmission Capacity Avoided Cost

Component	Avoided Cost Rate ($/kWh) (1)
Transmission Savings	$0.0135
Transmission Avoided Costs	**$0.0135**

(1) Rates are based on customers served at secondary voltage. Values were adjusted for line losses at 5.1%.

Energy-Related Costs Avoided: Solar DG and Flat Rate

Timing is an important consideration in the determination of the solar DG Avoided Costs. This is because the value of Avoided Costs can vary depending on factors such as peak demand periods (4CP) and fluctuating energy prices. For DME, analyzing these factors within the context of ERCOT market conditions is essential for accurately assessing the economic benefits of solar DG projects and optimizing their financial viability.Solar DG typically generates electricity during daylight hours with peak production occurring around midday when solar irradiance is highest, as shown in Figure 2-2. Factors such as weather conditions, cloud cover, and shading from nearby buildings or foliage can cause fluctuations in solar output, leading to reduced generation during periods of inclement weather or shading events. In comparison, the ERCOT market's usage pattern reflects the overall electricity demand in the Texas region, which tends to peak during hot summer afternoons due to increased air conditioning usage, as shown in Figure 2-2. While solar DG aligns with daytime electricity demand to some extent, it may not fully coincide with ERCOT's peak demand periods, particularly during late evening hours when solar generation is minimal or absent.

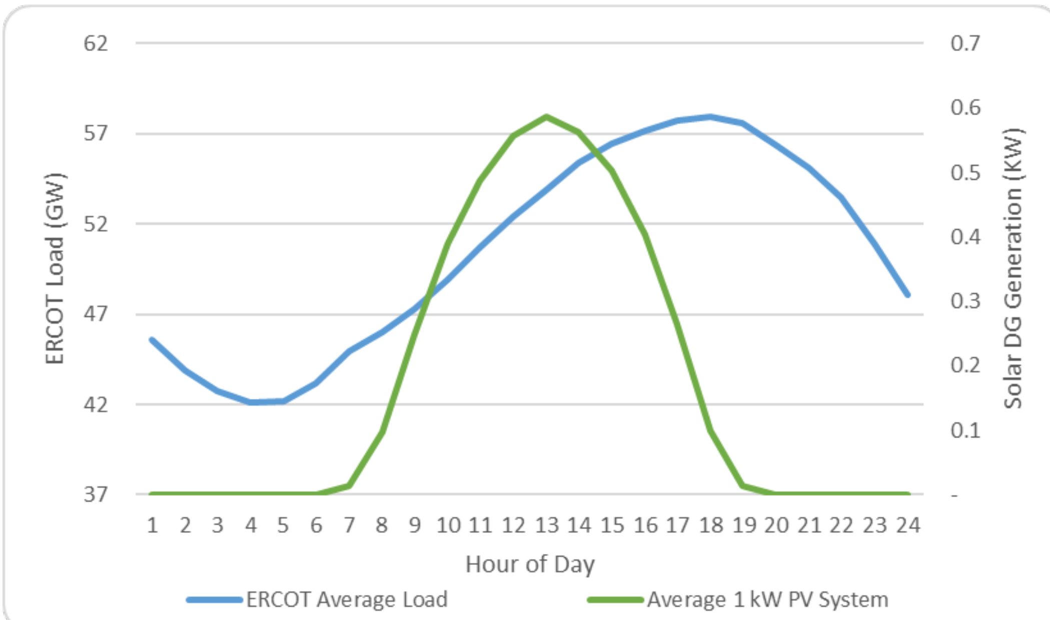


Figure 2-2. ERCOT Average Load Compared to Average Solar DG System[17]

Another consequence is that solar DG fails to alleviate the strain during periods of expensive energy. As depicted in Figure 2-3, energy prices in the ERCOT market peak in the evening when solar contribution is minimal or absent, exacerbating the cost burden on consumers. This discrepancy between solar generation and peak demand highlights the critical need for a diverse energy portfolio to uphold reliability and affordability, particularly during peak demand periods. Therefore, grid operators must balance solar DG output with other energy sources to ensure a stable and cost-effective electricity supply throughout the day, particularly during peak demand times.

For DME, the calculated Avoided Cost value comprises two key components:

[17] ERCOT load is the hourly average load in ERCOT from Oct. 2022–Sept. 2023. Generation profiles were provided by National Renewable Energy Laboratory PV Watts and assume a 1 kW fixed rooftop installation oriented at 180°.

ERCOT Energy Savings

- **ERCOT Energy Savings** – This element is based on the weighted average price for energy at the time of PV generation and is calculated as the sum of the ERCOT North Node Day-ahead price for each hour during the previous fiscal year multiplied by the PV generation for that same hour divided by the total PV generation, as shown in this formula.

$$\text{ERCOT Energy Savings} = \frac{\text{ERCOT Hourly Settlement Point Price} * \text{Hourly Solar DG Generation}}{\text{Total Annual Solar DG Generation}}$$

ERCOT Ancillary Services Savings

- **Ancillary Service (AS) Savings** – This component is based on the weighted average price for AS at the time of PV generation. ERCOT currently has five ancillary service products that support the transmission of energy to loads and the reliable operation of the bulk electric system. These five products are Regulation Service – Up (REG UP), Regulation Service – Down (REG DOWN), Responsive Reserve Service (RRS), Non-spinning Reserve Service (NSRS) and ERCOT Contingency Reserve Service (ECRS). ECRS was introduced in June 2023 to support grid reliability[18]. Due to its partial availability during the study period, it was not included in the analysis. The Ancillary Service Savings is calculated as the sum of the Scaled AS Price (the sum of the four different ancillary service products available during the study period in each hour scaled to its relevant proportion with overall ERCOT energy load) for each hour multiplied by the PV generation for that same hour during the previous fiscal year divided by the total PV generation, as shown in this formula.

$$\text{Ancillary Service Savings} = \frac{\text{Sum of Hourly AS Prices} * \text{Hourly Solar DG Generation}}{\text{Total Annual Solar DG Generation}}$$

ERCOT Energy and Ancillary Services Avoided Cost Rate

Table 2-2 details the proposed Avoided Costs.

Table 2-2
ERCOT Energy and Ancillary Service (AS)
Avoided Cost

Component	Avoided Energy and AS Cost Rate ($/kWh) (1)
ERCOT Energy Price Savings	$0.0524
ERCOT Ancillary Service Savings	$0.0044
ERCOT Energy Avoided Costs	**$0.0568**

(1) Rates are based on customers served at secondary voltage. Values were adjusted for line losses at 5.1%.

[18] https://www.ercot.com/news/release/2023-06-12-ercot-adds-new

DME's Avoided Costs for Customer with Solar DG

The calculated Avoided Cost rate for a DME customer with a solar DG system who is served at secondary voltage is summarized below in Table 2-3.

Table 2-3
Avoided Cost for a DME Customer with Solar DG

Component	Avoided Cost Rate ($/kWh) (1)
Generation Capacity Savings	$0.0000
Distribution Capacity Savings	$0.0000
Transmission Capacity Savings	$0.0135
ERCOT Energy Savings	$0.0524
ERCOT Ancillary Service Savings	$0.0044
DME Avoided Costs for Solar DG (2)	**$0.0702**

(1) Rates are based on customers served at secondary voltage. Values were adjusted for line losses at 5.1%.

(2) Rates are for generation facilities less than 1 MW. All resource entities with capacities of 1 MW or higher are required to register with ERCOT.[19]

Energy-Related Costs Avoided: Solar DG with Battery Storage – TOU Rate

Batteries store excess energy generated by solar panels during the day for use when customer usage exceeds solar generation. This technology enables solar DG customers users to maximize their self-consumption, reduce reliance on the grid, and potentially save money by avoiding peak electricity rates.

Despite its benefits, battery storage comes with some drawbacks. The upfront cost can be high, adding to the initial cost of a solar system, and battery storage has limited capacity, meaning it may not meet all energy needs during extended periods without sunlight. Additionally, battery systems incur efficiency losses during charging and discharging, have a limited lifespan requiring maintenance or replacement, and can have environmental impacts related to the manufacturing and disposal of the battery.

Battery Storage Benefits for Customers and the Utilities

When solar DG generates excess electricity during the day, customers feed it back into the grid, allowing a utility to either buy less from the market or sell excess energy into the market. However, this excess production often occurs when electricity demand is low, such as during the day when many people are at work and energy usage is minimal. Figure 2-2 shows the time at which solar DG generates power and the time at which the ERCOT market is experiencing the most demand. Figure 2-3 shows the time at which energy prices were the most expensive in the ERCOT market for calendar year 2023.

[19] https://www.ercot.com/files/docs/2021/01/07/Resource_Interconnection_Handbook_v1.94_03012023.docx

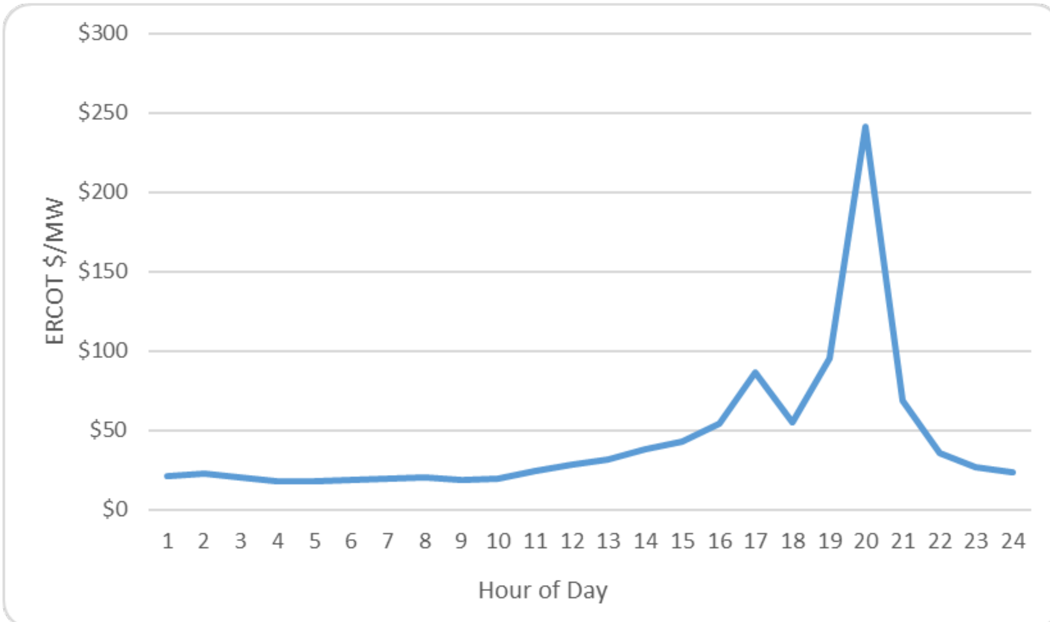


Figure 2-3. Average Hourly ERCOT Market Price

Battery storage offers a solution to this challenge by enabling solar customers to store excess energy during periods of high solar production and relatively low demand, and then discharge it during peak demand hours when electricity is more valuable.

Figures 2-4, 2-5, and 2-6 show the progression of residential usage with solar DG and with battery storage. In Figure 2-6, by integrating battery storage, this customer could capture and store excess energy during periods of surplus generation rather than immediately receiving credit. Subsequently, they could discharge the battery during peak usage times, effectively managing their energy consumption or even feeding surplus energy back into the grid. This adaptive approach not only optimizes the customer's energy usage but also assists utilities in mitigating peak demand pressures.

Please note that Figures 2-4, 2-5, and 2-6 are based on a low energy usage customer with a large solar DG installed. The data does not represent a specific customer.

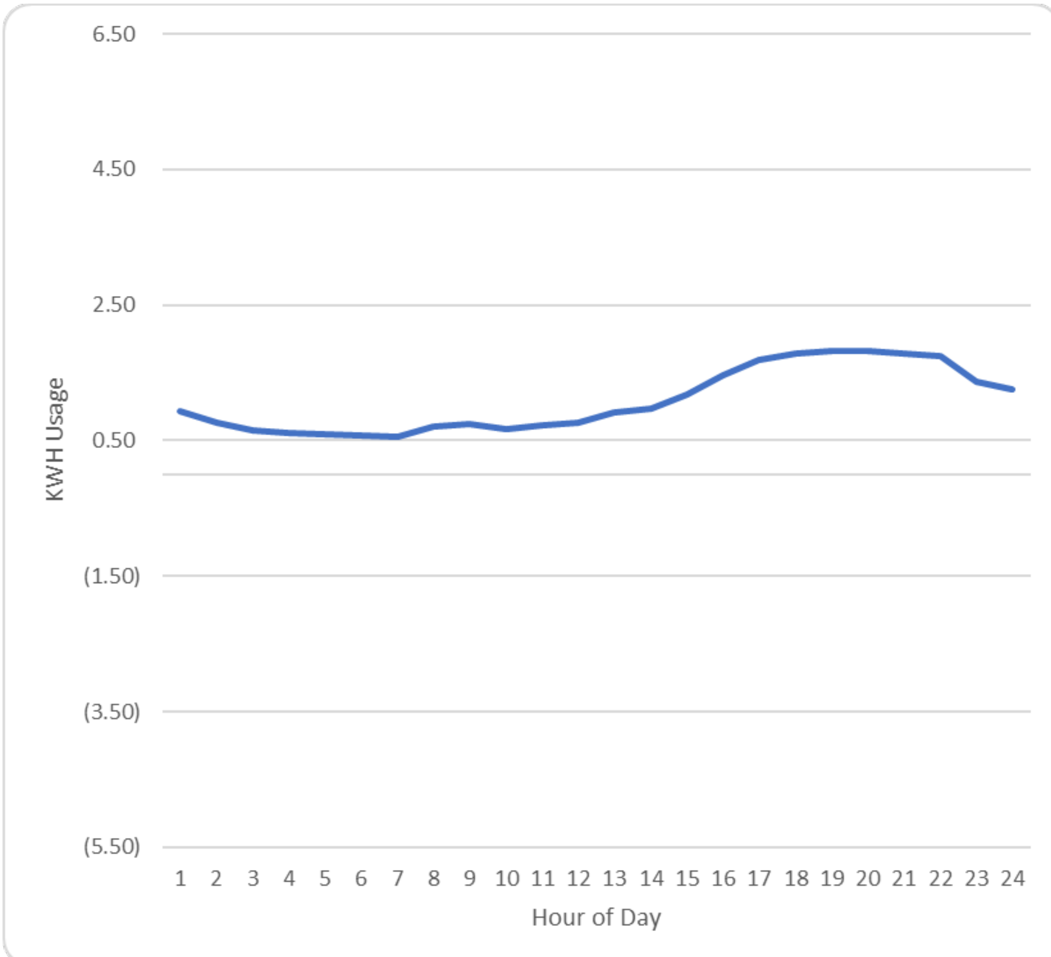


Figure 2-4. Representative Residential Usage

Figure 2-4 represents a residential customer with low energy usage. As seen in the graph, the customer uses the most energy in the late afternoon.

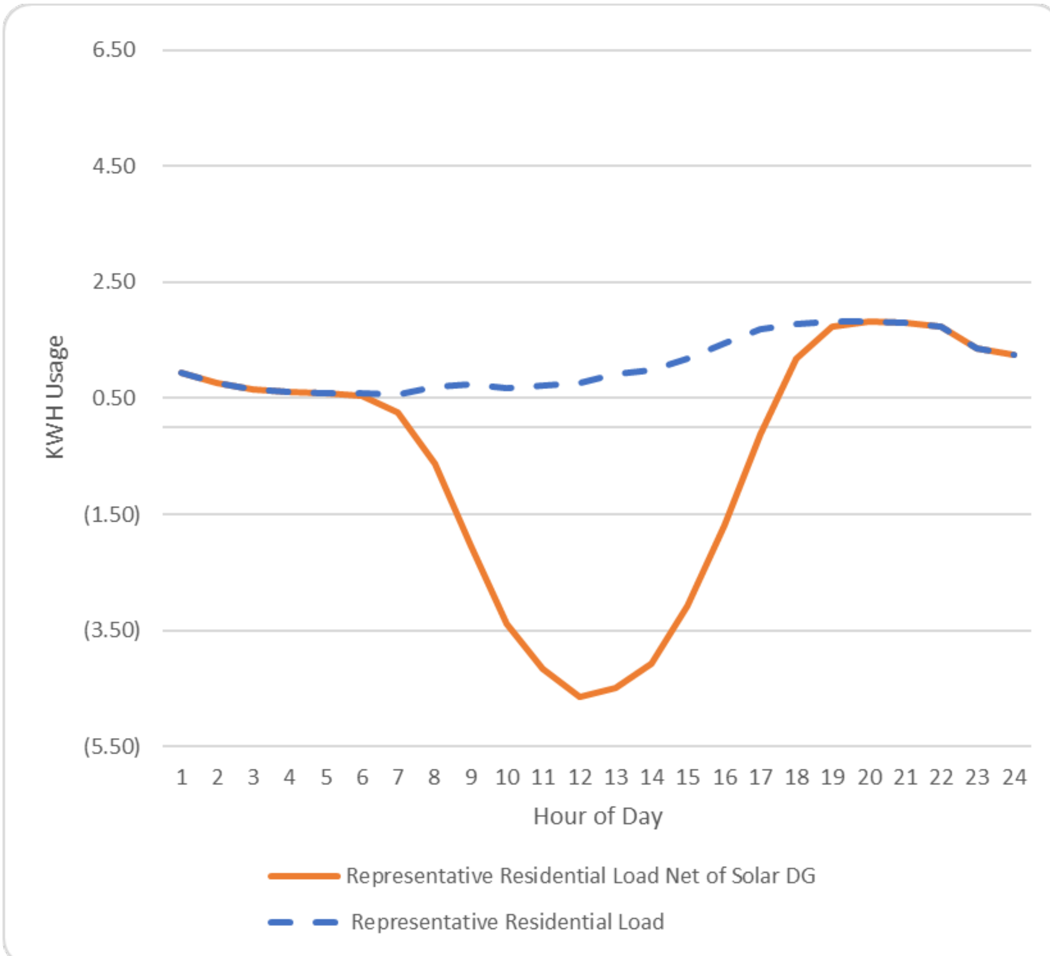


Figure 2-5. Representative Residential Usage with Solar DG

Figure 2-5, the blue dashed line represents the same residential customer in Figure 2-4. The solid orange line represents the residential load net of the solar DG generation. The solar DG is generating more power than the customer is using during midday.

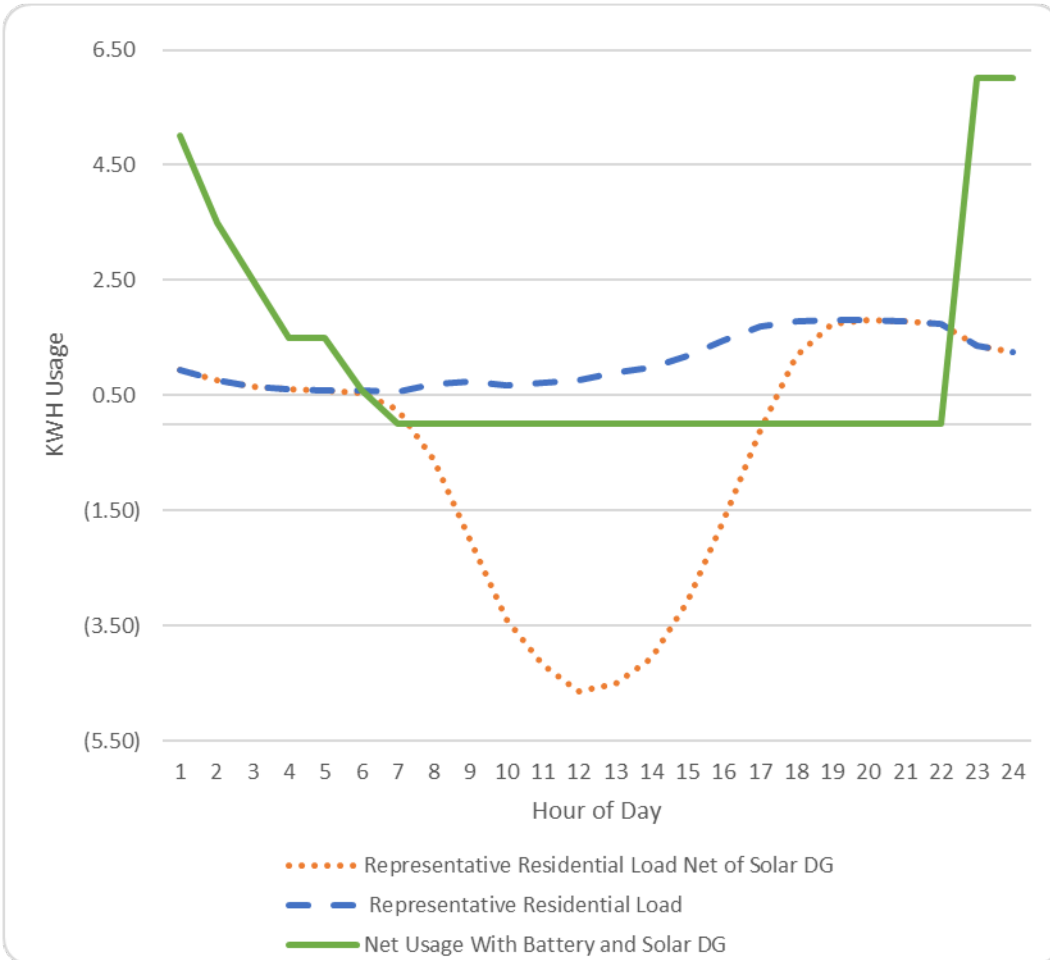


Figure 2-6. Representative Residential Usage with Solar DG and Battery Storage

Figure 2-6, the blue dashed line represents the same residential customer in Figure 2-4. The dotted orange line represents the residential load net of the solar DG generation. The green solid line represents the customers load as views from the utility. The customer is storing their excess energy in the battery, and then using that energy during the late afternoon peak periods.

Figure 2-6 represents a customer that is storing energy, and then using their own energy when the solar DG is not generating. The customer could also store their excess energy, and then sell the energy back to the utility at peak periods. In this way, battery storage can be designed to help utilities manage their peak demand more efficiently and reduce strain on the grid during peak periods. Additionally, by encouraging the adoption of battery storage among solar customers, utilities can enhance grid stability, reliability, and resilience, ultimately benefiting both the utility and their customers. However, as noted before, solar DG paired with battery storage can exacerbate the issue of fixed cost recovery for a utility, depending on the utility's retail rate structures.

Rate Design Considerations

Time-of-Use

Some utilities offer TOU rates where electricity prices vary based on the time of day, the day of the week, and the season. TOU rates send pricing signals that it is more expensive to generate or procure power during peak times. Time-based rates offer customers the chance to manage their electricity consumption and lower their bill by using power in off-peak periods. For customers with solar DG and battery storage, time-based rates can save the customer money (by using power off-peak) and can benefit the customer monetarily (by selling power to the utility at peak periods).

In summary, a TOU rate can be used to incentivize off-peak consumption and on-peak generation, aligning customer behavior with grid needs, maximizing the value of solar generation, and supporting grid stability. By offering lower electricity prices during off-peak hours, TOU rates encourage solar DG customers to utilize their excess energy or charge their battery storage systems when demand on the grid is lower, thus reducing strain during peak periods. Additionally, charging higher rates during peak demand hours ensures fair compensation for excess energy fed back into the grid, maximizing financial benefits for solar customers while supporting grid stability through load shifting and optimization of renewable energy integration. For this Study, we have not included an analysis of DME's potential fixed cost recovery issues related to solar DG paired with battery storage.

Table 2-4 illustrates the same methodology employed in generating DME's Avoided Cost rate of $0.0702/kWh, as seen in Table 2-3, but on a TOU and seasonal basis. Peak and Off-Peak Avoided Cost rates for both winter and summer periods were developed based on an average of hourly costs for DME. A detailed analysis of DME's seasonal and TOU cost basis was not conducted for this Study.

Incorporating TOU Avoided Cost rates alongside TOU retail rates could enhance the incentive for customers to strategically dispatch energy during peak hours. This approach would ensure that the utility accurately compensates solar DG customers based on the time when costs are avoided, aligning compensation with the actual value of the energy fed back into the grid.

Table 2-4
Representative Time-of-Use Avoided Cost Rate for Solar DG with Battery Storage

Component	Season/Period (1)	Summer Avoided Cost ($/kWh) (2)	Winter Avoided Cost ($/kWh) (2)
Generation Capacity Savings	Peak	$0.0000	$0.0000
Generation Capacity Savings	Off-Peak	$0.0000	$0.0000
Distribution Capacity Savings	Peak	$0.0000	$0.0000
Distribution Capacity Savings	Off-Peak	$0.0000	$0.0000
Transmission Capacity Savings	Peak	$0.1631	$0.0000
Transmission Capacity Savings	Off-Peak	$0.0000	$0.0000
ERCOT Energy Price Savings	Peak	$0.2337	$0.0307
ERCOT Energy Price Savings	Off-Peak	$0.0483	$0.0294
Ancillary Service Savings	Peak	$0.0229	$0.0034
Ancillary Service Savings	Off-Peak	$0.0039	$0.0025
Avoided Costs	**Peak**	**$0.4198**	**$0.0340**
Avoided Costs	**Off-Peak**	**$0.0522**	**$0.0319**

(1) Summer months are June–September, Winter months are all other months. Peak times are from 3 p.m.–7 p.m. every day. Off-Peak are all other times.

(2) Rates are based on customers served at secondary voltage. Values were adjusted for line losses at 5.1%.

Based on the simplified analysis provided in Table 2-4, a representative customer can be compensated at $0.42/kWh for energy sold back to the utility during summer peak periods. This is nearly six times the annual average Avoided Cost of approximately $0.07/kWh shown on Table 2-3. DME does not currently have TOU rates available for most customers (there is a TOU option for General Service Large customers). Due to this limitation, the analysis was simplified, and further investigation would be necessary if this approach were to be pursued.

Energy-Related Costs Avoided Based on Comparative PPAs

Under PURPA, Avoided Costs can be based on a utility's solar PPA prices.[20] These Avoided Costs can serve as the basis for setting the rates at which utilities purchase energy from QFs, including solar DG. These PPAs outline the terms under which solar energy developers sell electricity to utilities, often at a predetermined rate over a specified period.

DME's average solar PPA is $0.0244/kWh which is less than the energy market rate of $0.0524/kWh as shown in Table 2-3. This underscores the potential for cost savings linked to procuring solar energy compared to purchasing electricity directly from the market, emphasizing the potential discrepancy between awarding the full market rate and the actual cost of solar energy procurement.

If we used the current DME PPA price as the Energy Savings, DME's Avoided Cost rate would be $0.0379 per kWh, as indicated in Table 2-5.

[20] https://www.ecfr.gov/current/title-18/chapter-I/subchapter-K/part-292

Table 2-5
Avoided Cost Based on Recent DME Solar PPAs

Component	Avoided Cost Rate ($/kWh) (1)
Generation Capacity Savings	$0.0000
Distribution Capacity Savings	$0.0000
Transmission Capacity Savings	$0.0135
Solar PPA Price Savings (2)	$0.0244
ERCOT Ancillary Service Savings (3)	$0.0000
Avoided Costs for Solar DG	**$0.0379**

(1) Rates are based on customers served at secondary voltage. Values were adjusted for line losses at 5.1%.

(2) DME PPAs are variable only and do not include any firm capacity.

(3) Ancillary Services were assumed to be included in the PPA price.

Regardless of which Avoided Cost the City Council and DME choose to use, the Avoided Cost rate should be recalculated annually.

Section 3
VALUE OF SOLAR: SOCIETAL BENEFITS

This section summarizes the potential Societal Benefits derived from renewable energy and the options for valuing them through solar DG. The Societal Benefits represent the benefits to society resulting from reduced greenhouse gas (GHG) emissions and slowing climate change related impacts. In this section we summarize current GHG valuation markets and metrics including the GHG trading market, carbon capture, and a broad Federal Government valuation of a metric ton of GHG emissions.

Including Societal Benefits in the Value of Solar rate is a policy decision for the City Council. The City Council may choose to include an environmental or societal value component to the VOS credit that is related to or supports their policy objectives. Please note that this societal benefit may not be monetarily realized by the City, unlike the monetized cost avoidance related to energy or capacity benefits. It should be clear, however, that providing this VOS credit component to solar DG customers represents a revenue to solar DG customers paid for by non-solar DG customers. This distinction between a cost-based or monetized credit and a societal or non-monetized subsidy should be agreed upon by the City Council as a policy decision before implementation. If the City Council believes that it has value for the community, then the City Council should consider including Societal Benefits in their Value of Solar rate.

Greenhouse Gas Market

There is not a GHG federal market or a GHG state market in Texas. However, there is an organized GHG market in the Northeast called the Regional Greenhouse Gas Initiative (RGGI).[21] RGGI is a cooperative among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont to cap and reduce carbon dioxide (CO_2) emissions from the power sector. RGGI is the first cap-and-invest regional initiative implemented in the U.S. As a reference point, the December 2023 auction for CO_2 allowances settled at $14.88 per allowance. A CO_2 allowance represents a limited authorization to emit one short ton of CO_2.

U.S. Federal Government Tax Credits for Carbon Capture

Section 45Q of the U.S. Internal Revenue Code provides a tax credit for every metric ton of CO_2 that is captured and stored. Section 45Q was first introduced in 2008, and the amount paid for captured CO_2 increased after the passage of the Inflation Reduction Act in August 2022. How much carbon is worth depends on what is done with the carbon. It can vary from $60 per ton if used for enhanced oil recovery to $180 per ton if it is pulled from the atmosphere and stored in the ground.[22]

California Public Utility Commission Avoided Cost Calculator

The CPUC uses an Avoided Cost Calculator to determine the value of on-site solar and other DG resources. The avoided costs of electricity are modeled based on the following components: generation energy, generation capacity, ancillary services, transmission and distribution capacity, greenhouse gases, and high

[21] https://www.rggi.org/

[22] https://climate.mit.edu/ask-mit/how-much-captured-co2-worth

global warming potential gases.[23] The annual Total GHG Value in the CPUC model is $29.31 per ton in 2023 and is growing by 7.5% per year.[24]

U.S. Federal Government Social Cost of Carbon

The U.S. Federal Government uses the Social Cost of Carbon (SCC) to measure Societal Benefits. The SCC is an estimate of the cost of the damage done by a ton of carbon emissions.[25] The SCC is also used as an estimate of the benefit of any action taken to reduce a ton of carbon emissions. The SCC puts the effects of climate change into economic terms to help federal and state policymakers understand how emissions-related policies affect the economy. As previously indicated, the value of the reduction in non-carbon, regulated emissions (NO_x and SO_X) is assumed to be captured in the ERCOT market prices for power discussed in Section 2.

Background

The SCC was first estimated by the U.S. federal government to quantify the impacts from emitting one extra ton of carbon emissions. The federal government uses the SCC in their cost-benefit analyses when evaluating whether a policy to reduce emissions is justified. A cost-benefit analysis compares the total economic benefits of a proposed policy to its total economic costs.

The basis for the SCC is the estimated cost that is imposed on society as a byproduct of fossil-fueled power production. According to certain federal agencies, the harm to society from greenhouse gas emissions (which include but are not limited to CO_2):

> *. . . includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased flood risk natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services.*[26]

In 2009, the federal government set up the Interagency Working Group (IWG), a group of several federal departments that includes the U.S. Department of Energy and the U.S. Environmental Protection Agency (EPA), to determine the methodology and standards to be used to calculate the SCC. The SCC has varied significantly over the years depending on the administration in charge. The Obama administration set the SCC at $43/ton.[27] The Trump administration set the SCC between $3 and $5/ton. The Biden administration set the SCC at $51/ton in 2021. In 2022, the EPA issued an estimate of $190/ton.[28]

[23] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/der-cost-effectiveness

[24] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/der-cost-effectiveness

[25] https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

[26] U.S. Department of Energy's and the U.S. Environmental Protection Agency's Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990 at 2.

[27] https://www.brookings.edu/articles/what-is-the-social-cost-of-carbon/

[28] https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

Data Sources

IWG published the Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Report in February 2021 under Executive Order 13990.[29] This report provided the SCC on a per ton ($/ton) basis as shown in Table 3-1. To convert the cost per ton to a cost per kWh, we used the pounds of CO_2 per megawatt hour (MWh) generated (lbs./MWh). For Texas, we used the U.S. Energy Information Administration's (EIA) Texas Electricity Profile report (EIA Texas Report) for CO_2 emitted in Texas.[30]

Methodology

The Societal Benefit is calculated by multiplying the emission year dollar per metric ton of CO_2 (from Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990) by the prevailing CO_2 metric tons per kWh (from the U.S. EIA's Texas specific State Electric Profiles report, using the CO_2 lbs./MWh emissions statistic). This equation is shown below.

*Societal Benefit = Emission Year $/Metric ton CO_2 * Prevailing Metric ton $C0_2$/kWh*

Based on the IWG report, the value per metric ton of CO_2 for Emissions Year 2024 is $55. The metric ton of CO_2/kWh is 0.41 (894 lbs./MWh).[31] This calculation results in a Societal Benefit value of $0.0223/kWh for 2024 as shown in Table 3-1. Using the EPA's most recent report, this calculation results in a value of $0.0849 per kWh.

Table 3-1
Social Cost of Carbon

Emissions Year	$/Metric Ton of CO_2 (1)	Metric Ton of CO_2/MWh (2)	SCC $/kWh
IWG 2020	$51.00	0.41	$0.0207
IWG 2021	$52.00	0.41	$0.0211
IWG 2022	$53.00	0.41	$0.0215
IWG 2023	$54.00	0.41	$0.0219
IWG 2024	$55.00	0.41	$0.0223
IWG 2025	$56.00	0.41	$0.0227
EPA 2023	$190.00	0.41	$0.0849

(1) Table values are derived from Table A-1 in Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990.

(2) Texas specific State Electric Profiles report.

Whereas Avoided Costs (Section 2) are actual costs avoided by the utility from solar generation, the Societal Benefits of reducing carbon emissions are theoretical cost savings, since utilities in Texas do not

[29] https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf
[30] https://www.eia.gov/electricity/state/texas/
[31] Based on 2022 EIA data released Nov. 2, 2023.

pay for carbon emissions. In the short term, the utility does not avoid any costs or reduce expenses beyond its Avoided Cost. In the long term, there are potential societal cost savings due to increased societal and environmental health.

Societal Benefits Specific to DME

From a Societal Benefit point of view, the benefit of generating power with renewable energy is avoiding the emissions that would have been created from generating with fossil fuels.

Currently, carbon emissions are not regulated in Texas and there is no market value for carbon allowances in Texas. Additionally, because of DME's 100% renewable energy portfolio, DME neutralizes any carbon emissions associated with serving their customers by leveraging their renewable PPAs and RECs. DME has already "avoided" the emissions associated with providing electricity to their customers.

As a result, the Societal Costs outlined in this section are already being mitigated through this power supply strategy, and solar DG does not offer any additional value in this context. Therefore, we recommend that the Societal Benefit for solar DG for DME be set at zero ($0.00/kWh).

Other Considerations

Benefit of Local Generation

While DME currently meets 100% of their energy needs through renewable PPAs, there are arguments in favor of supporting local renewable generation in the form of solar DG. One program in support of local renewable generation devised by the North Central Texas Council of Governments and local stakeholders is the Dallas-Fort Worth Air Quality Improvement Plan.[32] While the specifics of its implementation and potential restrictions remain uncertain, it could entail constraints on local fossil fuel generation capacity and create greater demand for transmitting renewable energy to the region. No valuation associated with the Dallas-Fort Worth Air Quality Improvement Plan was included in the Avoided Cost analysis for this Study.

Cost of Integrating Renewables

While local solar generation can reduce transmission and distribution losses, it also raises concerns about land use, reliability, upfront costs, grid integration, and equity. In certain situations, these factors may offset the potential upside. We did not incorporate any costs associated with these items in the analysis.

Production and Disposal of Solar Panels

Solar panel fabrication requires chemicals, water, and electricity. Minerals and metals used in the production of solar panels are mined, which also requires consumables and electricity. Our analysis does not address any secondary environmental effects related to the production and fabrication of solar panels.

Solar panel disposal includes recycling any recyclable materials (glass, aluminum, copper) while the remaining materials are generally sent to a landfill. Toxic metals like lead and cadmium may also be present in solar panels. Our analysis does not include the recycling and disposal costs of the solar arrays at the end of their life.

[32] https://www.publicinput.com/dfwAQIP

While it is important to consider the social and ethical implications of solar array production and disposal, attempting to assign a monetary value in the context of solar panel manufacturing or mining is challenging and may vary significantly depending on the methodology used. Therefore, we did not incorporate any offsets associated with these items in the analysis.

Section 4
VALUE OF SOLAR: POLICY DRIVEN INCENTIVES

The third component considered in the value of solar is the City's and DME's policies. The City or DME may consider increasing the credit given to solar DG customers through policy as an incentive to encourage the adoption of rooftop solar systems. By providing additional incentives such as credits or financial benefits, utilities can help offset the initial investment costs for customers, making solar energy more financially attractive and accelerating the transition to renewable energy.

Similar to the Societal Benefits, including policy driven incentives in the VOS rate is a policy decision for the City Council. The City Council may choose to include a value component to the VOS credit that is related to or supports their policy objectives. Please note that this benefit may not be monetarily realized by the City, unlike monetized cost avoidance related to energy or capacity benefits. It should be clear, however, that providing this VOS credit component to solar DG customers represents a revenue to solar DG customers paid for by non-solar DG customers. This distinction between a cost-based or monetized credit and a non-monetized subsidy should be agreed upon by the City Council as a policy decision before implementation. If the City Council believes that it has value for the community, then the City Council should consider including Policy Driven Incentives in their Value of Solar rate.

The City currently has several policies, goals, programs, and plans in place to reach carbon neutral emissions by 2050 as a community, not just for electricity use. This section summarizes these goals and discusses the role that solar DG can play in these policies.

City of Denton and DME Renewable Energy Policies

The policies and plans created by the City and DME define the metrics to guide current and future energy strategies. The City's and DME's existing policies as related to renewable energy and carbon emissions are as follows:

Renewable Resource Plan (12/2017)

The Renewable Resource Plan, initiated in December 2017, aimed to assess the viability of achieving either a 70% or 100% renewable energy target while also establishing a reasonable timeline. Emphasizing diversification, the plan analyzed the impacts and risks associated with different renewable resource production methods across various locations, including the integration of DME's DEC resource. Following thorough deliberation, the PUB and the City Council endorsed the adoption of 100% renewable energy through wind and solar PPAs.

DME action: DME had to begin procuring renewable energy.

Requirement for local solar generation: None required.

Resolution No. 18-085 (2/2018)

With direction from the Renewable Resource Plan, the City Council passed and approved Resolution No. 18-085 on February 6, 2018, directing DME to meet the goal of providing their electric customers with 100% renewable energy. This goal was achieved in 2021 through solar and wind PPAs and RECs.

DME action: DME had to purchase 100% renewable energy.

Requirement for local solar generation: None required.

Simply Sustainable, A Framework for Denton's Future (2/2012 & 6/2020)

Originally adopted in February 2012, this document was updated in June 2020. The primary objective was to enhance efficiency and reduce energy consumption across municipal departments while also promoting energy efficiency among residents and local businesses. Strategy 3 of the plan focuses on enhancing the energy efficiency of existing homes and buildings. This includes exploring potential programs geared toward promoting electric vehicle (EV)/solar readiness. Designed as a dynamic framework, the document aimed to continuously evolve, with periodic reviews and updates of its goals and strategies every five to seven years.

DME action: None required.

Requirement for local solar generation: None required.

GreenSense Incentive Program (2010)

In 2010, DME began offering economic incentives to residential and commercial customers to develop rooftop solar DG facilities in addition to other energy efficient rebates through the GreenSense program.

DME action: Provide rebates for solar DG.

Requirement for local solar generation: None required.

DME Report to Sustainability Framework Advisory Committee Regarding the GreenSense Incentive Program (8/2022)

In August 2022, the DME staff submitted a comprehensive report to the Sustainability Framework Advisory Committee focusing on rooftop solar programs. The report included recommendations for the GreenSense incentives program. Specifically, the DME staff advocated for the removal of the solar rebate component within the GreenSense program. DME staff's rationale stemmed from the achievement of DME's goal of providing 100% renewable energy. Instead, DME proposed reallocating the budgeted funds toward other energy efficiency rebates within the GreenSense program, ensuring a more holistic approach to sustainable energy initiatives.

The report also recommended that a) DME should recover the appropriate fixed costs from each solar DG customer; and b) to the extent that a solar DG customer's credit exceeds the amount due to DME in any month, the credit should not offset other City of Denton billed utilities and should instead provide credits to the solar DG customer no higher than the Energy Cost Adjustment (ECA) rate. The ECA is a pass-through rate mechanism that is designed to fully recover fuel and purchased power costs. These "pass-through" rate mechanisms are a widely adopted industry practice.

City of Denton Climate Action Adaption Plan (Currently Under Consideration)

The City developed a comprehensive plan to better outline the essential steps toward achieving net-zero emissions by 2050. This initiative involved engaging with the public and the City Council through meetings to gather valuable insights into the pivotal opportunities and challenges pertaining to Denton's transition toward a low-carbon future. The plan is holistic in nature, addressing a wide array of factors beyond electric generation and encompassing transportation, businesses, and community involvement as integral components.

The City has not yet adopted the CAAP. If the City adopts the CAAP, the renewable energy goals include specific capacity goals for installed solar including solar DG. According to the CAAP, the current solar DG capacity is approximately 9 MW and the local solar DG goal is 53 MW by 2030 and 192 MW by 2048. Local solar can be solar DG or DME-owned solar that is near Denton. For Denton to achieve the aggressive goals outlined in the CAAP, the solar DG systems will likely have to be incentivized to meet the targets.

DME action: Not applicable yet.

Requirement for local solar generation: Not applicable yet.

This is relevant to the VOS rate discussion because the ability to achieve the customer-sited policy objectives is dependent on customers installing solar DG as a result of their own economic or social decisions. Currently DME's 100% renewable power supply objective does not rely upon customer sited solar DG installations. However, incremental solar DG installations could be considered energy efficiency improvements as increasing DME's portfolio of renewable resources could be mitigated by these sources of renewable energy. The VOS credit may impact customers' decision to install future solar DG or participate in future community solar projects.

City Policies Specific to DME

Of the policies and plans listed above, none of the policies require DME to provide an incentive to promote the installation of solar DG. Since DME has already achieved its goal of 100% renewable energy, it may be unnecessary to incentivize solar DG for several reasons. First, with renewable energy sources already comprising the entirety of their energy portfolio, DME has sufficient clean energy available for consumption, rendering additional solar generation redundant. Additionally, the cost-effectiveness of incentivizing rooftop solar diminishes when renewable energy sources already fulfill the energy demand without the need for supplementary generation. Redirecting funds from solar rebates toward other energy efficiency initiatives can further optimize resource allocation, addressing broader sustainability goals such as promoting energy conservation practices among consumers and catering to a wider range of consumers, and addressing varied energy needs within the community.

For Denton to achieve the aggressive goals outlined in the CAAP, the solar DG systems will likely have to be incentivized to meet the targets. DME could incentivize solar DG a variety of ways:

- Through the VOS rate.
    - The customers could be compensated at a rate above Avoided Cost for their personal investment. The amount of the credit may not be cost based and could be subjective. Depending on the policy, the customer may be paid this incentive indefinitely.
- Waive application or interconnection fees.
    - Waiving the application and connections fees will save the customer money at the time of installation. However, there is a cost for DME to provide these services. If the solar DG customer is not paying the fees, then the remaining customers will have to cover the costs.
- Streamline application or interconnection permits and inspections.
    - Streamlining the process will save the customer time and allow them to install their system faster.
- Grants or rebates for customers that install solar DG.

- Providing grants or rebates upfront will save the customer money at the time of installation. However, there is a cost for DME to provide these grants or rebates. If the solar DG customer is not paying the full cost of their solar DG, then the remaining customers will have to cover the costs.

- Low-cost loans.
  - Low interest rate loans will save solar DG customers money during the life of the loan. However, if DME offers loans at interest rates lower than what DME pays, then there is a potential subsidy from DME to the customer.

We recommend that the City Council and DME discuss the above options to make decisions that support the community's goals.

Federal Policies Supporting Solar DG

The federal government has offered a variety of programs over the years to support and incentivize solar DG. The Inflation Reduction Act extended the Federal Solar Tax Credit until 2035.[33] The credit is a tax credit that can be claimed on federal income taxes for a percentage of the cost of a solar DG system paid for by the taxpayer. For years 2022–2032, a tax credit can be claimed for 30% of installation costs for the following items:

- Solar electric panels
- Solar water heaters
- Wind turbines
- Geothermal heat pumps
- Fuel cells
- Battery storage technology

State Policies Supporting Solar DG

The state of Texas offers one incentive for customers who install solar DG:

- Texans who install solar can exempt the value the solar panels add to their properties when determining their property tax.[34]

[33] https://www.energy.gov/eere/solar/homeowners-guide-federal-tax-credit-solar-photovoltaics
[34] https://comptroller.texas.gov/ See the Texas Property Tax Exemptions data February 2024.

Section 5
INDUSTRY BENCHMARKING

As part of this Study, we reviewed other Texas utilities' approaches to metering and billing for customers with solar DG.

Austin Energy

Austin Energy (AE) is a municipally owned electric utility serving the city of Austin, Texas. With over 480,000 customers, AE is one of the largest public power utilities in Texas and the U.S. AE currently has an energy portfolio made up of 60% renewable energy and 40% non-renewable energy.[35]

AE employs a VOS rate system to compensate solar customers for energy generated by their on-site systems, incorporating three key components: Avoided Cost, Societal Benefits, and Policy Driven Incentives. AE utilizes the same approach outlined in this Report to calculate the three components of the VOS. Currently set at $0.0991/kWh, AE's VOS rate applies to all energy generated by solar DG and facilitated by dual metering, which enables separate tracking of energy generation and consumption. This arrangement allows AE to credit all solar generation at the VOS rate and bill consumption at the retail rate, a model known as Buy-All Sell-All.

DME currently does not have two meters, limiting them to measuring energy flow in a single direction at one time. Consequently, when a customer consumes more energy than they generate, the meter records a positive read, and vice versa. These limitations restrict DME's capacity to implement a Buy-All Sell-All approach.

Pedernales Electric Cooperative

Pedernales Electric Cooperative (PEC) is a member-owned cooperative (co-op) electric utility serving Central Texas. With over 400,000 customers, PEC is the largest co-op electric provider in Texas and one of the biggest in the U.S. PEC uses a similar approach to AE to develop their Sustainable Power Credit (VOS rate equivalent). However, PEC utilizes only the Avoided Cost portion and does not include any Societal Benefits or Policy Driven Incentives as part of their credit. Their reasoning is that since they are not actual and direct costs incurred by PEC, they would result in subsidies paid by non-solar DG members.[36]

As they operate under a NEM billing structure, PEC ensures members receive full retail credit for their generated electricity, with surplus energy fed back into the grid credited at a rate of $0.069554/kWh under the Sustainable Power Credit.[37]

[35] https://austinenergy.com/about/environment/renewable-power-generation

[36] https://www.pec.coop/wp-content/uploads/2023/11/Interconnected-Generation-Value-of-Solar-Study-Report.pdf

[37] https://www.pec.coop/dg-interconnection-rates/#:~:text=The%20Sustainable%20Power%20Credit%20has,PEC%20from%20direct%20avoided%20costs.

CPS Energy

CPS Energy (CPS) is the largest municipally owned electric utility in Texas and the U.S., serving over 800,000 customers in the city of San Antonio, Texas and surrounding areas. CPS currently has an energy portfolio made up of 10% renewable energy, 25% nuclear energy, and 65% non-renewable energy.[38]

CPS utilizes a NEM billing approach, giving customers full retail credit up to the amount they consume and providing an Avoided Cost rate for excess generation. Credits can be carried forward to subsequent bills. CPS has rooftop solar incentives to support the adoption of solar for small businesses, schools, and non-profit organizations that is based on a dollar per AC Watt of capacity installed.[39]

CoServ

CoServ is a member-owned electric cooperative serving North Texas with over 470,000 combined electric and gas meters. CoServ utilizes bidirectional meters and credits all kWh in excess of customer usage at $0.0821/kWh[40]. Credits can be used toward the non-generation portions of a customer's bill and if additional credits still exist, they can be applied to subsequent months' bills.

Garland Power and Light

Garland Power and Light (GP&L) is a municipally owned utility providing electric service to over 70,000 customers in the city of Garland, Texas. GP&L utilizes bidirectional meters and credits all kWh in excess of customer usage at $0.0669/kWh.[41]

Bryan Texas Utilities

Bryan Texas Utilities (BTU) is a municipally owned utility serving the city of Bryan, Texas and providing electric services to over 60,000 residents and businesses. BTU currently has an energy portfolio of 8% renewable, 15% market purchases, and 77% non-renewables.[42]

BTU compensates customers for the energy generated by their DG systems, crediting the value against their utility bills based on metered kWh input at BTU's applicable Power Supply Adjustment charge. Any surplus credit remaining after offsetting energy consumption can be requested as a check payment from BTU, with a request limit of twice annually.[43]

New Braunfels Utilities

New Braunfels Utilities (NBU) is a municipally owned utility serving the city of New Braunfels, Texas and providing electric service to over 50,000 residential and commercial customers. NBU gives full retail credit for any power generated by the customer which can be used to offset the amount of power purchased from NBU. However, NBU does not purchase excess generation.[44] Additionally, NBU's solar DG customers

---

[38] https://www.cpsenergy.com/en/about-us/programs-services/energy-generation.html

[39] https://www.cpsenergy.com/content/dam/corporate/en/Documents/CPSE%20Solar%20Program%20Manual.pdf

[40] https://www.coserv.com/help/how-is-dg-with-buyback-bill-calculated/

[41] https://www.gpltexas.org/residential/solar-installation-requirements

[42] https://www.btutilities.com/wp-content/uploads/2023/04/2022-BTU-Annual-Report-WEB.pdf

[43] https://www.boarddocs.com/tx/cobtx/Board.nsf/files/BZVJBK4C4688/$file/Electric%20Rates%202021%20FInal.pdf

[44] https://www.nbutexas.com/wp-content/uploads/2023/04/FY-2024-Electric-Rates.pdf

are assessed a surcharge of $1.58 per kW of system size.[45] NBU's solar DG customers are required to have two meters. NBU offers rebates on a $/watt of capacity installed.[46]

Georgetown Electric Utility

The City of Georgetown provides electric services to its citizens and is in the process of updating its existing NEM rate program. One recent change made was to adopt an avoided cost process for compensating excess energy from solar DG customers. The avoided cost is based on a historic analysis of ERCOT market pricing (including avoided AS costs) as well as avoided transmission costs, similar to the manner proposed for the DME Avoided Cost herein. The City of Georgetown recently reviewed a proposal from staff to move to a "Buy-All Sell-All" model for new solar DG, as well as to incorporate a fixed cost recovery fee for solar DG paired with battery storage.

DME

DME gives full retail credit for any power generated by the customer up to the amount of energy the customers uses. Customers who generate more solar power than they consume—referred to as net generators—receive a Renewable Cost Adjustment (RCA) for the surplus energy they produce on a $/kWh basis. DME's RCA rate utilizes the following formula to establish the RCA rates.[47]

$$\textit{Renewable Cost Adjustment} = \frac{\textit{Nodal Market Price * Renewables Hourly Output}}{\textit{Total Annual Renewables Production}}$$

The current RCA rate accounts for the ERCOT Energy Price component in Table 2-3. DME's RCA tariff permits rate adjustments on a quarterly basis. However, DME has not exercised the adjustment in several years. The current RCA rate is $0.0381/kWh.

Summary of Texas Solar DG Metering and Billing

As shown in Table 5-1 below, nearly all Texas utilities listed use net metering with full retail credit up to their customers' use (monthly netting) and then pay those customers an Avoided Cost rate for any excess generation. Only Austin Energy currently pays a VOS rate and has a Buy-All Sell-All metering and billing setup; however, the City of Georgetown has proposed a Buy-All Sell-All program.

[45] https://www.nbutexas.com/wp-content/uploads/2022/09/2022-Solar-Facts-and-FAQs.pdf
[46] https://www.nbutexas.com/wp-content/uploads/2024/01/23-20223_ResidentialSolarRebateApplicationGuidelines-02.pdf
[47] City of Denton Ordnance 20-1553.

Table 5-1
Review of NEM Programs for Selected Texas Electric Utilities

Utility	Billing Method	Metering Method	Credit Type: Up to Customers' Usage	Credit Type: Excess Generation ($/kWh)
Austin Energy	Buy-All Sell-All	2 meters	Value of Solar	VOS = $0.0991
Pedernales	Net Metering	1 meter	Retail Credit	AC = $0.0696
CPS	Net Metering	1 meter	Retail Credit	AC = $0.0600
CoServ	Net Metering	1 meter	Retail Credit	AC = $0.0791
Garland Power and Light	Net Metering	1–2 meters	Retail Credit	AC = $0.0669
Bryan Texas Utilities	Net Metering	1 meter	Retail Credit	Retail
New Braunfels Utilities	Net Metering	2 meters	Retail Credit	$0.0000
Georgetown (1)	Net Billing	1 meter	Retail Credit	AC = $0.04531
DME	Net Billing	1 meter	Retail Credit	RCA = $0.0381

(1) Georgetown recently proposed moving to a Buy-All Sell-All program for new solar DG customers, along with a fixed charge rate for solar DG plus battery storage customers.

Section 6
SUMMARY AND RECOMMENDATIONS

Value of Solar Rate

The Value of Solar rate includes three components: the Avoided Cost rate, the Societal Benefits, and the Policy Driven Incentives. We recommend a VOS rate be used in conjunction with the Buy-All Sell-All billing and metering.

Avoided Costs

The Avoided Cost rate can be calculated in a variety of ways as explained in Section 2. The DME Avoided Cost rate based on the ERCOT market is $0.0702/kWh. The Avoided Cost Rate based on a representative DME PPA is $0.0379/kWh. Therefore, for the Avoided Cost we recommend a flat rate between $0.0379 and $0.0702/kWh.

If properly managed, the installation of battery storage can increase the value of the generation provided by the customer. Therefore, for a customer with solar DG and battery storage, we recommend a time-based Avoided Cost rate as shown in Table 2-5. However, we recommend DME evaluate fixed cost recovery concerns with solar DG paired with battery storage prior to initiating a TOU Avoided Cost rate.

Regardless of which Avoided Cost the City Council and DME choose to use, the Avoided Cost rate should be recalculated annually.

We recommend that the Avoided Cost rate be set between $0.0379 and $0.0702/kWh.

Societal Benefits

Including Societal Benefits in the Value of Solar rate is a policy decision for the City Council. The City Council may choose to include an environmental or societal value component to the VOS credit that is related to or supports their policy objectives. Please note that this societal benefit may not be monetarily realized by the City, unlike the monetized cost avoidance related to energy or capacity benefits. It should be clear, however, that providing this VOS credit component to solar DG customers represents a revenue to solar DG customers paid for by non-solar DG customers. This distinction between a cost-based or monetized credit and a societal or non-monetized subsidy should be agreed upon by the City Council as a policy decision before implementation. If the City Council believes that it has value for the community, then the City Council should consider including Societal Benefits in their Value of Solar rate.

From a Societal Benefit point of view, the benefit of generating power with renewable energy is avoiding the emissions that would have been created from generating with fossil fuels.

Currently, carbon emissions are not regulated in Texas, and there is no federal or state market value for carbon allowances in Texas. Additionally, DME neutralizes any carbon emissions associated with serving their customers by leveraging their renewable PPAs and RECs. DME has already "avoided" the emissions associated with providing electricity to their customers.

As a result, the Societal Costs are already mitigated through this power supply strategy, and solar DG does not offer any additional value in this context.

Including Societal Benefits in a Value of Solar Rate is a policy decision for the City Council. We recommend that the Societal Benefit for solar generation for DME be set to $0.00/kWh unless the City Council believes that including the incentive has value for the community.

Policy Driven Incentives

Similar to the Societal Benefits, including policy driven incentives in the VOS rate is a policy decision for the City Council. The City Council may choose to include a value component in the VOS credit that is related to or supports their policy objectives. Please note that this benefit may not be monetarily realized by the City, unlike monetized cost avoidance related to energy or capacity benefits. It should be clear, however, that providing this VOS credit component to solar DG customers represents a revenue to solar DG customers paid for by non-solar DG customers. This distinction between a cost-based or monetized credit and a non-monetized subsidy should be agreed upon by the City Council as a policy decision before implementation. If the City Council believes that it has value for the community, then the City Council should consider including Policy Driven Incentives in their Value of Solar rate.

None of the various City policies require DME to provide an incentive to promote the installation of solar DG. For Denton to achieve the aggressive goals outlined in the CAAP, the solar DG systems will likely have to be incentivized to meet the targets.

Including Policy Driven Incentives in a Value of Solar Rate is a policy decision for the City Council. We recommend that the Policy Driven Incentive rate for solar DG for DME be set to $0.00/kWh unless the City Council believes that including the incentive has value for the community.

Recommended Rate to Compensate Customer Generation

Depending on whether the recent solar PPAs or the ERCOT market is used, the Avoided Cost rate varies from $0.0379 to $0.0702.

With DME's current Net Billing tariff, we recommend that DME pay the customers selling excess generation to the utility an Avoided Cost rate between $0.0379 and $0.0702/kWh.

Appendix A
Tables

Table A-1
Average Monthly Bill Comparisons – Net Consumer (1)

			Current DME Rates	Current DME Rates	VOS Rate			PPA Rate		
Line No.	**Type**	**Formula**	**Non-Solar**	**Net Billing**	**Net Metering (NEM)**	**Buy All Sell All**	**Net Billing**	**Net Metering (NEM)**	**Buy All Sell All**	**Net Billing**
	Usage Charge – $/kWh									
1	Gross Cust Usage		$0.0684 (2)		$0.0684	$0.0684		$0.0684	$0.0684	
2	Gross Cust Generation				$0.0702 (3)	$0.0702		$0.0379 (4)	$0.0379	
3	Bidirectional Net Energy Used			$0.0684			$0.0684			$0.0684
4	Bidirectional Net Energy Sold			$0.0684			$0.0702			$0.0379
	Usage/ (Generation) – kWh									
5	Gross Cust Usage		1,200		1,200	1,200		1,200	1,200	
6	Gross Cust Generation				(800)	(800)		(800)	(800)	
7	Bidirectional Net Energy Used			694			694			694
8	Bidirectional Net Energy Sold			(294)			(294)			(294)
9	Net Usage/ (Generation)		1,200	400	400	400	400	400	400	400
	Usage Billed									
10	Gross Cust Usage	= Line 1 * Line 5 OR Line 9	$82.08		$27.36 (5)	$82.08		$27.36	$82.08	
11	Gross Cust Generation	= Line 2 * Line 6 OR Line 9			$0.00 (6)	($56.16)		$0.00	($30.32)	
12	Bidirectional Net Energy Used	= Line 3 * Line 7		$47.49			$47.49			$47.49
13	Bidirectional Net Energy Sold	= Line 4 * Line 8		($20.13)			($20.66)			($11.15)
14	Total Usage Charge		$82.08	$27.36	$27.36	$25.92	$26.83	$27.36	$51.76	$36.34
15	ECA Charge – $/kWh		$0. 0447 (7)	$0.0447	$0.0447	$0.0447	$0.0447	$0.0447	$0.0447	$0.0447
16	ECA Billed	= Line 5, Line 7 OR Line 9 * Line 15 (8)	$53.64	$31.04	$17.88	$53.64	$31.04	$17.88	$53.64	$31.04
17	RCA Charge – $/kWh			$0.0381 (9)						
18	RCA Billed	= Line 8 * Line 17		($11.21)						
19	TCRF Charge - $/kWh		$0.0135(7)	$0.0135	$0.0135	$0.0135	$0.0135	$0.0135	$0.0135	$0.0135
20	TCRF Billed	= Line 5, Line 7 OR Line 9 * Line 19	$16.20	$9.37	$5.40	$16.20	$9.37	$5.40	$16.20	$9.37
21	Facility Charge – $/month		$8.67 (10)	$8.67	$8.67	$8.67	$8.67	$8.67	$8.67	$8.67
22	Average Monthly Bill	= Lines 14 + 16 + 18 + 20 + 21	$160.59	$65.23	$59.31	$104.43	$75.91	$59.31	$130.27	$85.42
23	Difference From Current Net Billing				-9%	60%	16%	-9%	100%	31%

(1) Average monthly bill based on summer usage in Table A-2.
(2) DME residential summer usage charge as of 10/01/2020.
(3) ERCOT VOS rate per Table 2-3.
(4) ERCOT VOS rate per Table 2-5.
(5) Line 1 (retail rate) is only applied to customer usage if it exceeds the amount that solar DG generates for NEM.
(6) Line 2 (VOS or PPA rate) is only applied to solar DG that exceeds the customer usage for NEM.
(7) DME energy cost adjustment charge and transmission cost recovery factor as of 04/01/2024.
(8) Line 15 (ECA rate) is only applied to customer usage if it exceeds the amount that solar DG generates for NEM.
(9) DME renewable cost adjustment charge as of 10/01/2020.
(10) DME residential facility charge as of 10/01/2020.

Table A-2
Hourly Summer Load Profiles – Net Consumer (1)

	Buy All Sell All		NEM Billing	Net Billing	
Hour	Monthly Usage	Monthly Generation	Net Billed/ (Credit)	Customer Buys from DME	Customer Sells to DME
1	47	0	47	47	0
2	42	0	42	42	0
3	38	0	38	38	0
4	35	0	35	35	0
5	32	0	32	32	0
6	30	(0)	30	30	0
7	29	(4)	25	25	0
8	29	(25)	5	5	0
9	31	(51)	(20)	0	(20)
10	34	(73)	(39)	0	(39)
11	39	(90)	(51)	0	(51)
12	46	(101)	(55)	0	(55)
13	53	(105)	(52)	0	(52)
14	59	(100)	(41)	0	(41)
15	63	(91)	(28)	0	(28)
16	67	(75)	(8)	0	(8)
17	70	(54)	16	16	0
18	72	(26)	46	46	0
19	72	(5)	67	67	0
20	69	(0)	69	69	0
21	65	0	65	65	0
22	64	0	64	64	0
23	60	0	60	60	0
24	54	0	54	54	0
	1,200	(800)	400	694	(294)

(1) Usage and generation based on representative customer for illustrative purposes. A net consumer customer is a customer that consumes more energy than their solar DG generates.

Table A-3
Average Monthly Bill Comparisons – Net Generator [1]

Line No.	Type	Formula	Current DME Rates: Non-Solar	Current DME Rates: Net Billing	VOS Rate: Net Metering (NEM)	VOS Rate: Buy All Sell All	VOS Rate: Net Billing	PPA Rate: Net Metering (NEM)	PPA Rate: Buy All Sell All	PPA Rate: Net Billing
	Usage Charge – $/kWh									
1	Gross Cust Usage		$0.0684 [2]		$0.0684	$0.0684		$0.0684	$0.0684	
2	Gross Cust Generation				$0.0702 [3]	$0.0702		$0.0379 [4]	$0.0379	
3	Bidirectional Net Energy Used			$0.0684			$0.0684			$0.0684
4	Bidirectional Net Energy Sold			$0.0684			$0.0702			$0.0379
	Usage/ (Generation) – kWh									
5	Gross Cust Usage		1,200		1,200	1,200		1,200	1,200	
6	Gross Cust Generation				(1,600)	(1,600)		(1,600)	(1,600)	
7	Bidirectional Net Energy Used			638			638			638
8	Bidirectional Net Energy Sold			(1,038)			(1,038)			(1,038)
9	Net Usage/ (Generation)		1,200	(400)	(400)	(400)	(400)	(400)	(400)	(400)
	Usage Billed									
10	Gross Cust Usage	= Line 1 * Line 5 OR Line 9	$82.08		$0.00 [5]	$82.08		$0.00	$82.08	
11	Gross Cust Generation	= Line 2 * Line 6 OR Line 9			($28.08) [6]	($112.32)		($15.16)	($60.64)	
12	Bidirectional Net Energy Used	= Line 3 * Line 7		$43.65			$43.65			$43.65
13	Bidirectional Net Energy Sold	= Line 4 * Line 8		($43.65)			($72.88)			($39.35)
14	Total Usage Charge		$82.08	$0.00	($28.08)	($30.24)	($29.23)	($15.16)	$21.44	$4.30
15	ECA Charge – $/kWh		$0.0447 [7]	$0.0447	$0.0447	$0.0447	$0.0447	$0.0447	$0.0447	$0.0447
16	ECA Billed	= Line 5, Line 7 OR Line 9 * Line 15[8]	$53.64	$28.52	$0.00	$53.64	$28.52	$0.00	$53.64	$28.52
17	RCA Charge – $/kWh			$0.0381 [9]						
18	RCA Billed	= Line 8 * Line 17		($39.55)						
19	TCRF Charge - $/kWh		$0.0135[7]	$0.0135	$0.0135	$0.0135	$0.0135	$0.0135	$0.0135	$0.0135
20	TCRF Billed	= Line 5, Line 7 OR Line 9 * Line 19	$16.20	$8.61	$0.00	$16.20	$8.61	$0.00	$16.20	$8.61
21	Facility Charge – $/month		$8.67 [10]	$8.67	$8.67	$8.67	$8.67	$8.67	$8.67	$8.67
22	Average Monthly Bill	= Lines 14 + 16 + 18 + 20 + 21	$160.59	$6.26	($19.41)	$48.27	$16.58	($6.49)	$99.95	$50.11
23	Difference From Current Net Billing				-410%	672%	165%	-204%	1498%	701%

(1) Average monthly bill based on summer usage in Table A-4.
(2) DME residential summer usage charge as of 10/01/2020.
(3) ERCOT VOS rate per Table 2-3.
(4) ERCOT VOS rate per Table 2-5.
(5) Line 1 (retail rate) is only applied to customer usage if it exceeds the amount that solar DG generates for NEM.
(6) Line 2 (VOS or PPA rate) is only applied to solar DG that exceeds the customer usage for NEM.
(7) DME energy cost adjustment charge and transmission cost recovery factor as of 04/01/2024.
(8) Line 15 (ECA rate) is only applied to customer usage if it exceeds the amount that solar DG generates for NEM.
(9) DME renewable cost adjustment charge as of 10/01/2020.
(10) DME residential facility charge as of 10/01/2020.

Table A-4
Hourly Summer Load Profiles – Net Generator [(1)]

	Buy All Sell All		NEM Billing	Net Billing	
Hour	Monthly Usage	Monthly Generation	Net Billed/(Credit)	Customer Buys from DME	Customer Sells to DME
1	47	0	47	47	0
2	42	0	42	42	0
3	38	0	38	38	0
4	35	0	35	35	0
5	32	0	32	32	0
6	30	(0)	30	30	0
7	29	(9)	21	21	0
8	29	(49)	(20)	0	(20)
9	31	(102)	(71)	0	(71)
10	34	(146)	(112)	0	(112)
11	39	(180)	(141)	0	(141)
12	46	(203)	(157)	0	(157)
13	53	(210)	(157)	0	(157)
14	59	(199)	(141)	0	(141)
15	63	(183)	(119)	0	(119)
16	67	(150)	(83)	0	(83)
17	70	(108)	(37)	0	(37)
18	72	(52)	20	20	0
19	72	(10)	62	62	0
20	69	(0)	69	69	0
21	65	0	65	65	0
22	64	0	64	64	0
23	60	0	60	60	0
24	54	0	54	54	0
	1,200	(1,600)	(400)	638	(1,038)

(1) Usage and generation based on representative customer for illustrative purposes. A net generator customer is a customer that generates more energy from their solar DG than they consume.

NewGen Strategies & Solutions

225 Union Blvd., Ste 450, Lakewood, Colorado 80228
Phone: (720) 924-7134
Email: jschuepbach@newgenstrategies.net
www.newgenstrategies.net