GAP Process Generic Scenario 3:
A Streamlined Economic Analysis for Community Solar in the Rocky Mountain West

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Community Solar Value Project

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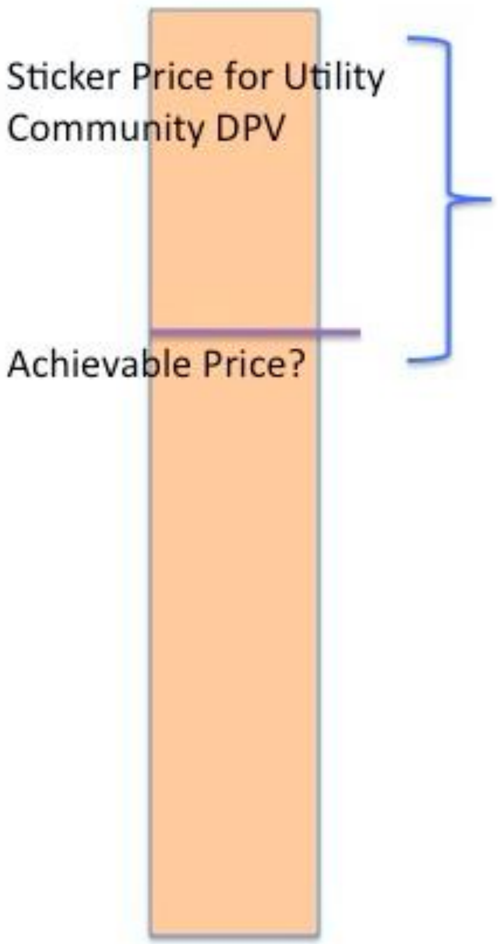
What is the GAP?



The GAP analysis is named for need to fill the gap between the baseline “sticker price” on a solar procurement and the net value that the utility can accept, in order to achieve competitive pricing on the program offer.

The GAP analysis is a process to “Get A Price” that reflects strategic DER value, but conforms closely enough to utility norms that it can be achieved and accepted by decision-makers in a relatively short time.

Methodology for the Study

The GAP analytic process evolved through a series of modeling exercises, supplemented by reviews from the Community Solar Value Project (CSVP) Utility Forum participants, led by Sacramento Municipal Utility District (SMUD) and the Platte River Power Authority. Models completed for these utilities were transformed into **generic scenarios** that preserved some situational characteristics, while replacing others to increase model replicability. A third model was based on available data for a Southwest Desert Utility (IOU).

This generic scenario pertains to a wholesale utility for local public power utility customers in the **Rocky Mountain West**. As noted, this scenario does not use specific utility data, but it presents a realistic hypothetical case for utilities and stakeholders that share similar issues and characteristics. *Readers are advised to review the GAP Process Summary Report before delving into this specific modeling report.*

Basis for the GAP Analytic Process

- One metric often used in evaluating resource acquisition decisions is the Levelized Cost of Energy (LCOE)
- LCOE is defined as the net present value (NPV) of project costs divided by the NPV of kWh output evaluated over the project life
- Traditionally, since most electricity resources were procured from central station projects on the transmission grid, only the NPV of project *costs* were compared
- When considering DERs, it is important to evaluate the *net* LCOE*,* which also incorporates incremental *benefits* of distributed PV on a levelized basis, i.e., the LBOE
- Even without including every possible benefit, the *net LCOE* analysis provides a more valid comparison of DPV resources

Equations

CSVP defines the LBOE categories as falling into four areas:

- Generation
- Transmission
- Distribution
- Societal

The equations for calculating the net LCOE are:

- $LCOE_{DPV\ NET} = LCOE_{DPV\ GROSS} - LBOE_{DPV}$
- Where, ↖PPA Price ↖DPV Benefits

$LBOE_{DPV} = LBOE_{GENERATION} + LBOE_{TRANSMISSION} + LBOE_{DISTRIBUTION} + LBOE_{SOCIETAL}$

Once the $LCOE_{DPV\ NET}$ is calculated, the utility's non-bypassable wires charge may be included, as usual, for bottom-line CS program pricing.

While some alteration of the wires charge may be warranted, most utilities find that very difficult to achieve. Modifications to support better pricing may be presented as an Adjusted PPA Price or Gross PPA Price + credit.

DPV Value Streams / Screening and Analysis

To identify appropriate value streams for assessment, the first step is to collect data specific to the utility designing the CS program. This is accomplished with a *data collection form*. Some utility data should be readily available. Regarding solar value, the process encourages utility staff to provide *ranges of values* for DPV benefit categories that may be difficult to quantify.

For different regional scenarios in this study, the DPV values were based on available data from participating utilities. Then, ranges were estimated for data not readily available, utilizing the best data available for the region or for utilities with similar characteristics. A sample utility data request is illustrated below, and on the following slides

For the Rocky Mountain West Case, data was provided by a JAA, including not only wholesale-level data, but also pertaining the its distribution utility members. This provided a fuller picture, with the aim of offering competitive community-solar customer pricing.

Purpose of the CSVP Scenario for the Rocky Mountain West

- The CSVP team developed generic scenarios to demonstrate value and pricing for Community Solar (CS) fleets in various geographic regions of the country
- The purpose of these analyses is to illustrate the impacts of various solar fleet configurations and distributed solar values customized for regions of the country with varying solar resource potential and distributed resource benefits
- This analysis for the Rocky Mountain West was designed to demonstrate the value and economic viability of a 5-MW fleet of PV systems, provided by a wholesale supplier (JAA), where power is relatively low-cost
- The analysis takes the perspective of a distribution utility that would tap into the resource described above
- In addition, the analysis demonstrates a simplified approach to CS program pricing, which incorporates DPV benefits, and a modified approach for full cost recovery of the program from CS program customers

Methodology for Valuing and Pricing the DPV Resource

- CSVP defines the LBOE categories as falling into four areas:
  - Generation
  - Transmission
  - Distribution
  - Societal
- The equations for calculating the net LCOE are:
  - $LCOE_{DPV\ NET} = LCOE_{DPV\ GROSS} - LBOE_{DPV}$
  - Where,

$LBOE_{DPV} = LBOE_{GENERATION} + LBOE_{TRANSMISSION} + LBOE_{DISTRIBUTION} + LBOE_{SOCIETAL}$

- Once the $LCOE_{DPV\ NET}$ is calculated, the utility's non-bypassable wires charge is typically added, to approximate the CS program pricing that retail utilities might see. For this case, a modified approach was used, to focus on cost recovery for lost revenues and program costs

Universe of Categories for GAP Benefit Analysis

- Avoided costs of conventional wholesale power**
- Avoided/deferred conventional generation capacity investment**
- Fuel price hedging**

- Avoided transmission losses
- Avoided transmission ancillary services
- Reduced distribution line losses
- Distribution ancillary services
- Improved distribution capacity utilization; may avoid/defer upgrades

- Reduce GHG and other emissions**
- Reduce water use**
- Conserve ag land, sensitive land
- Meet local sustainability goals
- Other compliance values**

- Solar geographic diversity benefits, risk management
- Potential resilience benefits
- Solar siting, design & operational flexibility to capture strategic benefits

- Potential DR companion measures
- Potential customer-side storage
- Potential added project-design values, e.g., shading

** Available to centralized or DPV projects

Methodology for Valuing and Pricing the DPV Resource

- The methodology is designed for a simplified analysis of a few, relatively high-value benefits of DPV
- The goal is not to “stack the bar chart” of DPV benefits as high as possible, but to estimate an approximate value of DPV that enables the utility to price the CS product competitively in the marketplace between conventional rate tariffs and third-party NEM product offerings.
- Selecting a few of the highest value benefits for the utility, and using ranges of values and conservative values will help to avoid internal debate over the right numbers
- For the Rocky Mountain West case, we tested on five value-categories for the LBOE analysis. This list was longer than typically tested, but the analysis found it would take four of these to fill the GAP
  - Avoided Transmission Access Charges
  - Strategic Solar Design – Fixed Tilt Vs. Single-Axis Tracking
  - Avoided Transmission Energy Losses
  - Coincident Demand Reduction Value
  - Distribution Upgrade Deferral Value

For This Case

- A hypothetical public power utility with a JAA power supplier located on the Rocky Mountain Front Range (TMY3 data for a Front Range Colorado location was used for the solar PV performance modeling)
- A 5-MW CS fleet of fixed-tilt PV systems strategically located, with the intention to capture as many distribution upgrade deferral benefits as practical
- Estimated PPA price of the 5-MW DPV fleet: $0.65/kWh
- 30-yr PPA executed between a developer and the JAA
- Utility-led, tariff-based CS program w/ full wires charges
- Very low avoided wholesale power purchase costs
- Analyzed a modification to CSVP's typical pricing methodology, to recover all program related costs and potential lost revenues

Data Collection and Development for the Rocky Mountain West Scenario

- Data was reviewed and analyzed for the DPV values listed below. Based on the documentation of ranges of data provided by utility sources, as well as other data sources, the DPV values were estimated utilizing the best data available for the region.

DATA VARIABLE	DESCRIPTION	UNITS	ACTUAL VALUE	ESTIMATED VALUE AT LOW END OF RANGE	ESTIMATED VALUE AT HIGH END OF RANGE
PV SYSTEM COSTS					
· PV System Costs	· The PPA price or LCOE of a 1 MW distributed PV system	$/kWh	$0.065	$0.05	$0.07
GENERATION SYSTEM LEVEL					
· Avoided wholesale energy and capacity purchases during PV production hours for EACH of the following PV system configurations: ○ Single Axis Tracking ○ Fixed-Tilt Mount (35-40°) ○ Horizontal Mount (canopy)	· The blended avoided wholesale cost of energy and capacity is calculated by running the hourly PV production profiles through the wholesale power pricing model to determine the hourly energy and capacity savings from avoided wholesale purchases. The hourly energy/capacity savings are summed for the year and divided by the number of PV kWhs produced in the year to determine the blended cost rate.	$/MWh	$35.00	$28* *This is the Value of Solar (VoS) range regardless of tracker configuration.	$35* *This is the Value of Solar (VoS) range regardless of tracker configuration.
· New generation capacity deferral or avoidance	· The value of new planned generation ($/MW) or PPAs ($/MWh) from non-solar resources that may be deferred or avoided from distributed solar projects.	$/MW-year or $/MWh (cite applicable years)	$3.96/kW month (co-incident demand)	$3.96/kW-month	$3.96/kW-month
TRANSMISSION SYSTEM LEVEL					
· Avoided transmission line losses	· The line losses on the transmission system that are avoided as a result of distributed PV generation. If data is not available for real-time PV production, then system averages for transmission losses may be used.	%	1.82%	1.82%	1.82%
· Avoided Transmission Access Charges	· The value of transmission services during the periods of PV generation (based on transmission price schedules). If data is not available for real-time PV production, then system averages may be used.	$/MWh	$16.10	N/A	N/A

1. Avoided Transmission Access Cost (TAC) Benefits

- Not all transmission costs may be avoided on a 1:1 basis
- Yet, we know now that DPV avoids significant Transmission Access Charge (TAC) costs; several sources are above beyond EIA's forecasted levelized cost estimate of $0.016/kWh
- Several studies have indicated that TACs in the 3-cent per kWh range or higher in the western US
- For this hypothetical case in the Rocky Mountain West, current U.S. EIA forward-pricing forecasts were used, which resulted in a value of a $0.016/kWh LBOE

2. Strategic DPV Design Benefit

- The strategic design benefit in this scenario is analyzed as the incremental benefit of the avoided wholesale power cost from a single-axis tracking (SAT) system compared to a fixed-tilt solar project design.
  - This analysis was conducted by analyzing the hourly output of the two PV system designs and the hourly wholesale energy price for the region.
  - The analysis determined that there was no incremental benefit in terms of avoided wholesale power costs between the two systems
  - There will likely be an incremental benefit from SAT in terms of coincident demand reduction with utility systems loads, but this value is currently minimal.
- Given current parameters, there is no incremental benefit of SAT; however, there is a significant risk-management benefit. SAT may provide additional *benefits in the future* as wholesale prices, pricing structures and use patterns change.
- SAT may also provide benefits from the customer perspective since it produces more energy in summer months, when retail rates are higher
- While it is recognized that the value of SAT projects may provide additional value in the future, under the current wholesale power cost structure, the value of strategic design used for this case was $0.00/kWh

3. Avoided Transmission Losses

- Avoided transmission system losses are often included in DPV value analyses, because DPV generation reduces system energy requirements, which in turn reduces the amount of energy that needs to be delivered to the utility; it also reduces the losses that would have incurred, with that delivered energy
- Transmission system losses have traditionally been under-valued in DPV benefit analyses, as very little real-time data has been available on avoided line losses during the periods of PV generation. As a result*, transmission loss annual averages* are typically used.
- However, DPV generation occurs when system loads and ambient temperatures are highest, which typically corresponds to increased line losses. This is an area that CSVP has determined needs more research, as time-differentiated line-loss analyses may yield much higher savings than current annual averages indicate.
- For this analysis, we used the annual average line loss method, and a value of 1.8% per year

3. Avoided Transmission Losses (cont'd)

- The LBOE of avoided transmission line losses was determined by multiplying 1.8% of the DPV fleet's annual energy generation by the Levelized Avoided Cost of Energy (LACE) from PV generation. The LACE value used in this analysis was provided by a regional utility and was estimated at $0.035/kWh
- The resulting LBOE of transmission line losses was $0.0003/kWh. This value is negligible in terms of its impact on the LBOE analysis due to the low low line losses and the low LACE.

4. Coincident Demand Reduction

- DPV can provide utility system benefits by reducing system loads during periods where utilities are experiencing peak demand. This is particularly true when there is a relatively high coincidence factor between the DPV generation and utility peak demand period. It is also a greater savings opportunity for utilities that are billed by their wholesale providers for peak demand, based on their highest monthly peak. This was the case for the Rocky Mountain West scenario: coincident demand reduction from DPV could provide significant value.
- Specifically, this value could be provided by:
  - Reducing utility peak demand charges, and
  - Potentially deferring or avoiding future generation capacity additions
- The generic utility represented by this case, like many other utilities in the region, offers capacity payments for parallel generation that exports to the distribution grid. For this analysis, a proxy for a utility capacity tariff was converted to an energy-based value, which resulted in a LBOE of 1.1 cents/kWh over the analysis period.

5. Distribution System Upgrade Deferral

- System upgrade deferrals may not occur with most DPV system installations, and the GAP analytic process is based on generally taking a conservative approach.
- However, utility planners accept that conditions sometimes do exist where a distribution deferral value would be realized. For this case, the GAP analysis team created a realistic scenario, wherein:
  - ◆ Several distribution feeder lines on the utility system may be requiring system upgrades
  - ◆ DPV installations were strategically sited along these feeder lines
  - ◆ The DPV installations were of significant size to potentially have an impact on deferring an upgrade
  - ◆ Not all, but some of these DPV installations would prove out
- If *half of the installations* in this case defer upgrades that would otherwise be needed, savings would total $1M for an average of 7 years.
- The deferral value was determined by summing the amount of interest payments (at 7.5%) that would have been required to finance improvements, deferred for 7 years. The LBOE of these deferred payments was $0.009/kWh

Results from the Net LCOE Analysis

- $LCOE_{DPV\ NET} = LCOE_{DPV\ GROSS} - LBOE_{DPV}$
- Where,
  - $LCOE_{DPV\ GROSS}$ = PPA Price
  - $LBOE_{DPV} = LBOE_{TRANSMISSION\ COSTS} + LBOE_{STRATEGIC\ PV\ DESIGN} + LBOE_{Tx\ LOSSES} + LBOE_{COINCIDENT\ DEMAND\ REDUCTION} + LBOE_{DISTRIBUTION\ UPGRADE\ DEFERRAL}$
- Resulting in,

DPV Value Category	Value (kWh)
LCOE of DPV (PPA Price)	**$0.065**
Avoided Transmission Costs	$0.016
Strategic DPV Design	$0.000
Avoided Transmission Losses	$0.0003
Coincident Demand Reduction	$0.011
Distribution Upgrade Deferral	$0.009
Adjusted PPA Price	**$0.029**

Pricing Analysis of the Community Solar Program

- The final step of the valuation of DPV in CS applications for the Rocky Mountain West case was to develop an indicative pricing estimate.
- This regional scenario employed an alternative approach to program pricing that sought to capture all the program costs from the customer subscribers, insuring that all program related costs (including lost revenues from customers switching from the conventional rate tariff to the CS rate tariff, and the program design and management costs) were imbedded in the program price.
- This approach is designed for utilities that wish to make the program 100% economically self-sustaining by the subscribers.
- The methodology for determining the “break-even” price for full cost recovery of the program by the utility is to set a a subscriber price that results in a Benefit-Cost Ratio of 1.0. That is, the program costs equal the program benefits over the life of the program, resulting in a cash flow neutral position at the end of the program. As a result, all other economic metrics will also be breakeven or positive, including nominal lifecycle cash flow, average annual cash flow, NPV, and IRR.

Pricing Analysis of the Community Solar Program (cont.)

- Based on this modified, indicative pricing approach for the Rocky Mountain West scenario, the break-even program price (before the addition of the non-bypassable wires charge) was determined to be $0.065/kWh.
- This value was determined by starting with the adjusted PPA price of $0.029/kWh, and then solving for a break-even PPA price by setting the Benefit-Cost Ratio to 0. This resulted in a "Break-Even" price of $0.065/kWh, indicating that lost revenues and program administration costs were $0.036/kWh on a levelized basis.
- Thus, the new adjusted PPA price for the energy component of the CS program was $0.0065/kWh, and after adding the non-by-passible wires charge the final indicative price was estimated at $0.111/kWh

CS Program Price Analysis Results

Price Category	Value (kWh)
Baseline "Break-Even" Price for All Program Costs	$0.065
Non-Bypassable Wires Charge	$0.046
Community Solar Program Price Offering	**$0.111**

Results for the Rocky Mountain Case

In practice, the utility has options in pricing a community solar offer. It can accept the net-value analysis and pass through a cost based on this derived net value. Most utilities allow adjustment to the PPA price, as an alternative to passing through the exact PPA price, which is, at best, a gross LCOE. By incorporating a modest collection of widely acceptable DPV benefits, the utility can adjust the PPA and offer more competitive, win-win pricing.

Another option might be to adjust the wires cost. However, many utilities are adverse to that strategy.

A third option would be to provide a rebate or embedded benefit payment, such as an incentive for customers who participate in other programs that the utility deems valuable. (For example, the CSVP promotes “solar-plus DR or storage” options or participation in a load management TOU rate.)

In any case, the next steps might be to perform a customer-facing economic analysis and market research, to understand exactly where local customers’ community solar price point is.

The Analyst and the Project

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The Community Solar Value Project is focused on improving community-solar program value, through solar + storage + DR and other strategies, at electric utilities in Sacramento and beyond. Led by Extensible Energy, LLC, and drawing on support from four additional firms, CSVP provides expert utility-process leadership and tools.
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The CSVP acknowledges the contributions of various utilities to this effort. Details and updates are available at the CSVP website, http://www.communitysolarvalueproject.com. The authors underscore that the case described is, as intended, a hypothetical, and does not represent specific utility programs or policies.