GAP Process Generic Scenario 2:
A Streamlined Economic Analysis On Local Solar Options for a Central California Municipal Utility

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Community Solar Value Project

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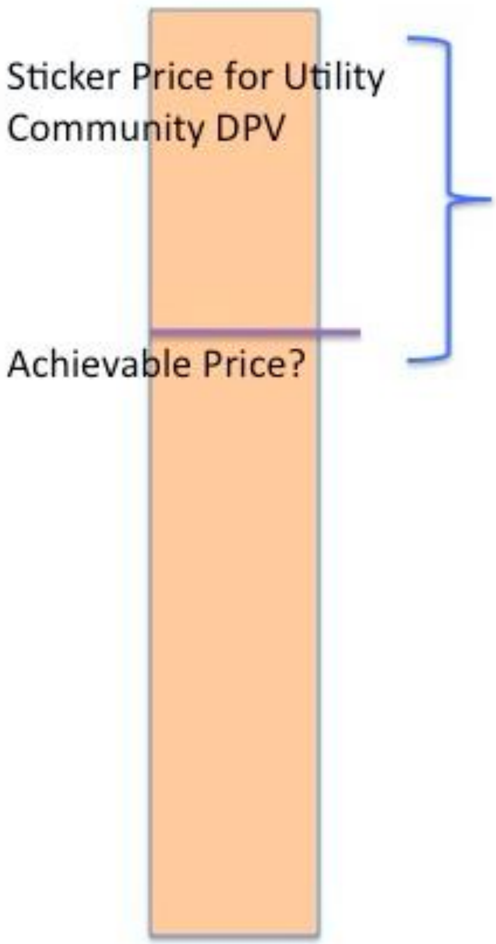
What is the GAP?



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. One more model was based on available data for a Southwest Desert Utility (IOU).

This generic scenario pertains to a **large, municipal utility in Central California.** By no surprise, some characteristics are akin to those at SMUD; however this scenario does not use specific utility data. Instead, it and draws data to present a realistic hypothetical case for utilities and stakeholders everywhere, facing similar issues. *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

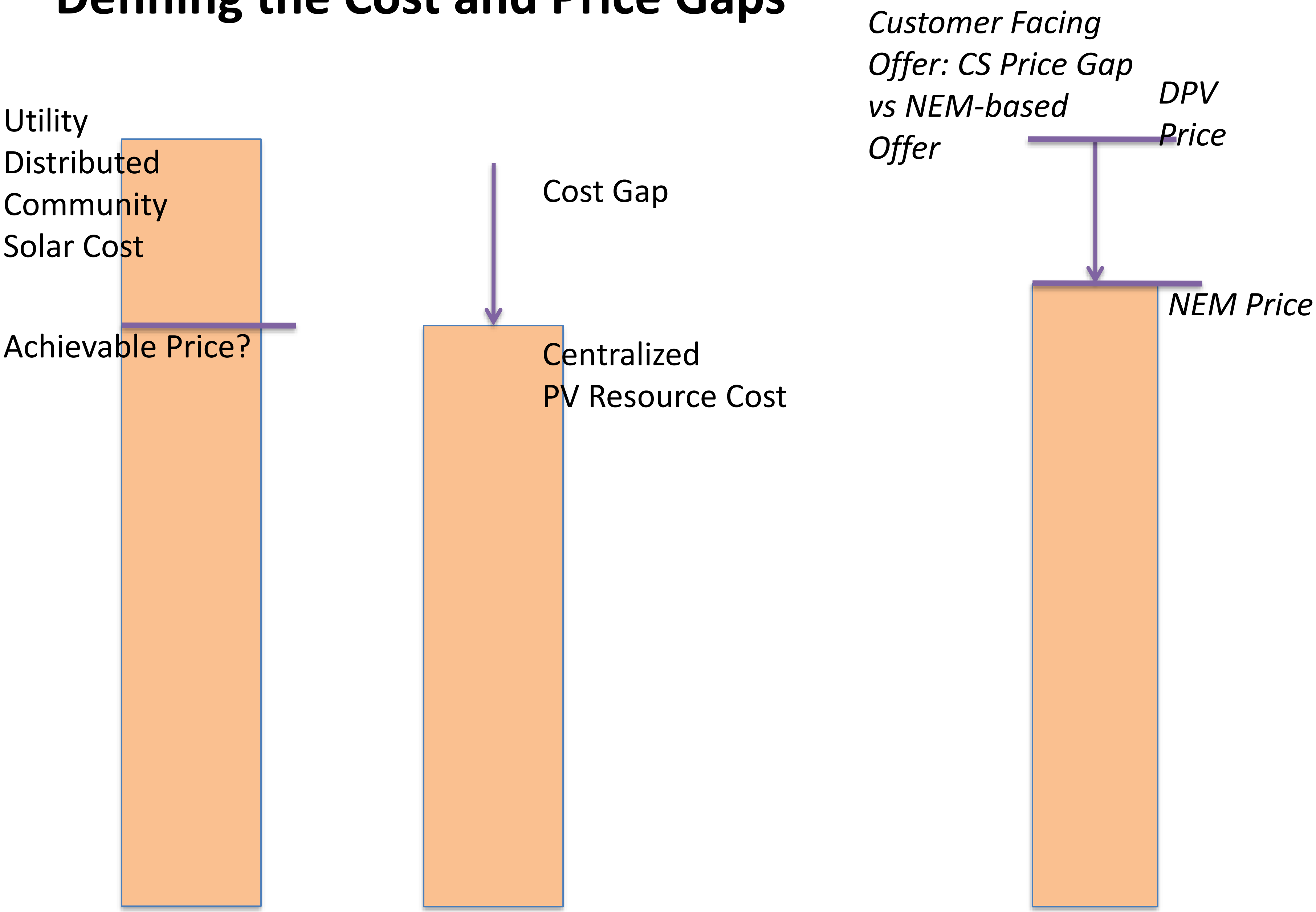
Purpose of the CSVP Scenario For a Central California Muni

- The purpose of each CSVP GAP Scenario is to demonstrate how the methodology would be applied to inform utility decisions about their community solar resource procurement, and how, in turn, that high-value procurement can support a competitive program price.
- In this case, the utility has access to solar energy from large, transmission-scale solar projects. These project have an apparently lower cost ($LCOE_{gross}$) but the narrative argument for the program expresses a preference among community-solar customers for a more diverse set of options, including distributed PV projects on the local grid.
- In addition, this utility wishes to test a hypothesis that providing a community solar choice could slow the move to customer-sited Net Energy Metered (NEM) projects, thus allowing for a more gradual approach to the DER transformation that is already underway.

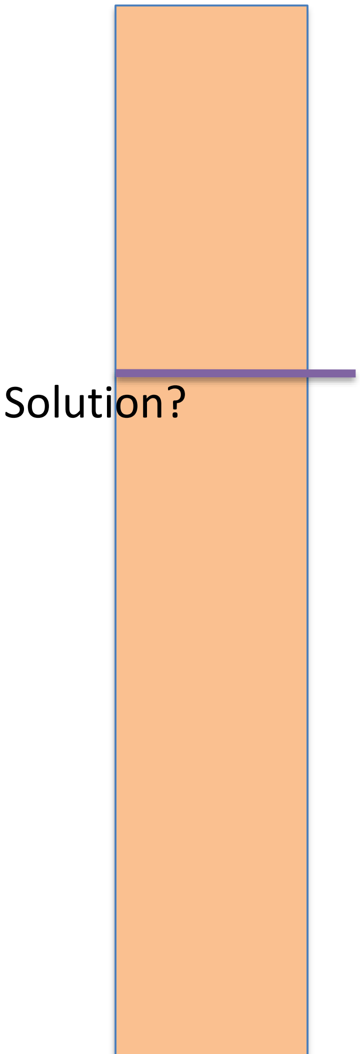
Methodology for Testing This Scenario For a Central California Muni

1) Define the cost gap between Central PV (CPV) and Distributed PV (DPV) and the price gap between a utility-led offer and and a more typical rooftop solar option.
2) Design the methodology for closing the cost gap
3) Run the analysis, using a select number of high value variables. Consider a mixed-fleet (CPV + DPV) option.
4) Determine the impacts on both the DPV and CPV/DPV fleet costs
5) Draw on available market research data to derive an estimated “customer retention” value, and consider steps to verify or alter local community-solar program expectations.

Defining the Cost and Price Gaps



This Scenario Includes a Mixed Fleet



For This Case:

- Muni service territory
- 2015 Low-Cost FT CPV: $0.05/kWH
- Initial average cost, DPV options: $0.075
- Utility-led CS program; 30-yr PPA on resource
- Tariff-based program, w/ some wires charges
- NEM-based lease or purchase rooftop as the alternative
- Test estimated value of customer retention

- **Fleet approach**
- **20 MW CPV**
- **6 MW DPV: rooftop, SAT, carports**
- **Successive DPV project-cost reductions reflected in the fleet rate**
- **Increasing DPV to be considered**

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.

Data Collection and Development

A first step is to request data for the DPV values listed below. Often, a range of estimated values may be provided, based on literature review and standard values, as well as actual utility data.

DATA VARIABLE	DESCRIPTION	UNITS	ACTUAL VALUE (If Known)	ESTIMATED VALUE AT LOW END OF RANGE	ESTIMATED VALUE AT HIGH END OF RANGE
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 ○ Horizontal Mount	• The blended avoided wholesale cost of energy and capacity is calculated by running the hourly PV production profiles through the utility's wholesale power pricing model to determine the hourly energy and capacity savings from avoided wholesale purchases. The hourly energy and 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		$0.045/kWh	$0.09/kWh
• New generation capacity deferral or avoidance	• The value of new planned generation ($/MW) or PPAs ($/MWh) from non-solar resources that may be deferred or avoided from distributed solar projects.	$/MW-year or $/MWh	$0.026/kWh	$0.005/kWh	$0.11/kWh
TRANSMISSION SYSTEM LEVEL					
• Avoided transmission line losses	• The line losses on the transmission system level 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.	%		2%	4%
• Avoided transmission charges	• Avoided transmission service charges	$/MWh			
• Avoided ancillary service costs	• The value of avoided ancillary service costs during the periods of PV generation (based on transmission ancillary cost price schedules). If data is not available for real-time PV production, then system averages may be used.	$/MWh	$0.0000005/ MWh	-$0.000005/MWh	$0.000015/MWh

Data Collection and Development for the SMUD Realistic Hypothetical (cont.)

DATA VARIABLE	DESCRIPTION	UNITS	ACTUAL VALUE (If Known)	ESTIMATED VALUE AT LOW END OF RANGE	ESTIMATED VALUE AT HIGH END OF RANGE
DISTRIBUTION SYSTEM LEVEL					
• Avoided distribution line losses	• The average line losses on the distribution system level that are avoided as a result of distributed PV generation. If data is not available for real-time PV production, then system averages or low and high ranges, for distribution system losses may be used.	%		1.5%	3.5%
• Ancillary service value	• The value of ancillary services provided by distributed PV, including but not limited to: • frequency and regulation support • reactive power • voltage support • spinning reserves These values, or aggregate value, should ideally be expressed in \$/MWh-year which is an average value of the \$/MWh benefits over the course of a year during the periods of PV production for the 37.5° fixed-tilt system.	\$/MWh-year			
• Improved capacity utilization, and potentially deferred or avoided equipment upgrades and/or O&M	• The value of improved capacity utilization and deferred/avoided equipment upgrades and/or O&M	\$/MW-year (cite applicable years)	\$0.01/kWh	\$0.0/kWh	\$0.07/kWh
• Grid resiliency • Disaster recovery • Micro-grid capability	• The value of distributed PV resources in providing grid resiliency and disaster recovery related services	\$/MWh or \$/MW-year		\$0.01/kWh	\$0.023/kWh

Data Collection and Development (cont.)

DATA VARIABLE	DESCRIPTION	UNITS	ACTUAL VALUE (If Known)	ESTIMATED VALUE AT LOW END OF RANGE	ESTIMATED VALUE AT HIGH END OF RANGE
SOCIETAL BENEFITS					
• Avoided CO_2 emissions • Other avoided emissions • Avoided water consumption • Regulatory compliance (i.e., RPS, IRP, S-REC)	• These potential benefits are aggregated to capture any potential societal benefits that are directly monetized by the utility, or are anticipated to be directly monetized within the 30-year analysis period.	\$/MWh	\$0.005-\$0.007/kWh	\$0.001/kWh	\$0.04/kWh
UTILITY STRATEGIC VALUE BENEFITS					
• Economic development; sustainability targets • Grid modernization and electrification • Additional risk-management values • Customer service, including equity	• As these utility strategic value benefits are difficult to quantify and/or monetize, please provide brief written summaries on how these values positively impact the utility, its goals, and its overall mission as applicable.	Qualitative Discussion			
• Customer retention / competitiveness value	• The customer retention value is the value that distributed community solar PV resources has in terms of keeping the customer and not losing them (and their revenues) to a third party PV provider.	\$/MWh			

- Based on this data and on a written narrative of program objectives, the team selected three variables for the LBOE analysis:

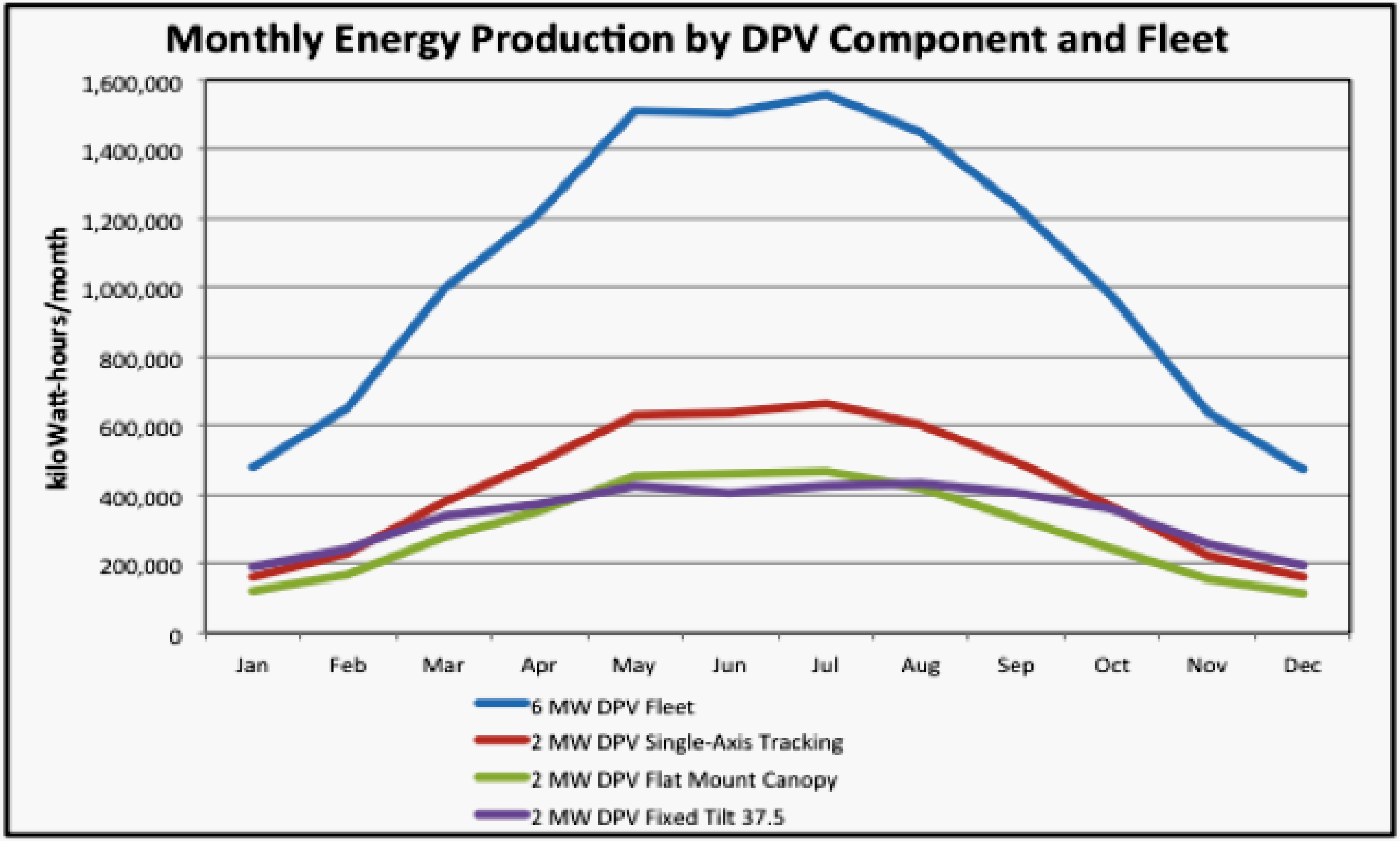
◆ Strategic DPV Design
◆ Transmission Avoided Costs
◆ Customer Retention Value

1. Strategic DPV Design Benefit

- Identify the incremental benefit for each system type, based on incremental wholesale power avoided costs, relative to delivered cost of Centralized PV:
  - 2 MW fixed-tilt rooftop PV system: $0.000/kWh
  - 2 MW flat-mount parking canopy PV system: $0.0041/kWh
  - 2 MW ground-mount single-axis tracking PV system: $0.0133/kWh

- Taken together, the incremental benefit of this fleet, relative to CPV
  - $LBOE_{DPV}$ = $0.0064/kWh

In SMUD's service area, flat-mount carports offer summer-peak production benefits that supplant high-priced CAISO resource. Construction cost and siting benefits are also considerable, but not counted here.



Annual Energy Production Comparison:

- **Fixed Tilt: Baseline**
- **Flat Mount Canopy: -12%**
- **Single-Axis Tracking: +24%**

2. Transmission Avoided Cost Benefits

- Not all transmission costs are 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 "postage stamp" avoided cost estimate of $0.0184/kWh.
- Example: Clean Coalition findings on TAC escalation rate for CAISO—supported by the even more robust avoided-cost findings in other studies—suggests $0.03/kWh
- For this hypothetical case, a conservative $0.01/kWh incremental LBOE

3. Utility Customer Retention: A Test Case

1) Novel, and yet widely understood by utilities.

2) The Customer Retention Benefit is the value of DPV in attracting customers to a utility-led solar program, instead of a third-party offering of NEM solar. It represents the portion of avoided lost revenues attributed to customers subscribing to the community-solar program, instead of a third-party rooftop option.

3) For this analysis, CSVP reviewed national market research data, and estimated that over time, 15% of customers were likely to opt for a rooftop NEM choice, *if a competitive utility-provided choice were not available*. Thus, 15% of the non-bypassable wires charge *could* be valued as the Customer Retention Value. Various utilities' feedback suggests the need for more research to verify the % of customers in this segment, but at the same time, acceptance that the value of retaining customers could be as high as 15% of total wires-charge revenue.

4) This conservative approach resulting in a first year value of $0.09/kWh and an LBOE of $0.0117/kWh

Results from "Closing the Gap" Analysis

- $LCOE_{DPV\ NET} = LCOE_{DPV\ GROSS} - LBOE_{DPV}$
- Where,

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

$LBOE_{DPV} = LBOE_{STRATEGIC\ DESIGN} + LBOE_{TRANSMISSION} + LBOE_{CUSTOMER\ RETENTION}$

$LBOE_{DPV}$= 0.64 cents + 1.0 cents + 1.17 cents

$LBOE_{DPV}$= 2.81 cents

- Then,

$LCOE_{DPV\ NET}$ = 7.5 cents – 2.81 cents = 4.69 cents

- And,

$LCOE_{DPV\ NET} \cong LCOE_{CPV\ GROSS}$

4.69 cents ≅ 5.00 cents

Impacts of Results on a Community Solar Fleet

Gross LCOEs for Centralized and Distributed PV, in Comparison With Net LCOE of DPV Incorporating Three DPV-Characteristic Benefits

$LCOE_{CPV\ GROSS}$	$LCOE_{DPV\ GROSS}$	$LCOE_{DPV\ NET}$
\$0.0500/kWh	\$0.0750/kWh	\$0.0469/kWh

LCOE Analysis Results for a Hybrid Community Solar Fleet

20 MW CPV $LCOE_{GROSS}$	6 MW DPV $LCOE_{GROSS}$	26 MW Hybrid Fleet $LCOE_{GROSS}$	26 MW Hybrid Fleet $LCOE_{NET}$
\$0.0500/kWh	\$0.0750/kWh	\$0.0556/kWh	\$0.0493/kWh

Price Gap Analysis of Community Solar Versus NEM

- The final step of the Valuation of Distributed PV in Community Solar Applications for SMUD was to review the fleet LCOEs of the CS program, compared to the LCOE of NEM projects.
- CSVP collected information that supported an LCOE estimate for residential NEM PV of **$0.1323/kWh**
- Compared to the CS fleet LCOE of **$0.0493/kWh** this results in a difference **$0.0830/kWh**.
- This leaves considerable room for adding in an appropriate wires charge into the CS product offering – while still providing a highly competitive and strategic bottom-line CS program price.

Next Steps

- **For the utility:** GAP analysis in this case is used as a screening tool, informing the utility that a mixed portfolio of large-scale CPV plus a smaller fraction of DPV would meet utility cost and pricing goals. The utility must then design a program that micro-targets customers, whether they prefer a green-tariff approach to CPV or an offer designed for strategic local projects (e.g., community redevelopment or solar-plus). All aspects of the offer, including how pricing would change as the fleet develops, must be addressed. Protection of choice for rooftop customers must also be addressed.
- For the industry: CSVP recommends DOE-support to make the more generic GAP analysis tools more available to utilities in different geographic regions. This includes, in particular, development of the narrative-driven process, aimed at quickly getting a program in place, so that its exact value in a given utility situation, could be evaluated.

Small Print: Acknowledgements and Disclaimer

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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.

The Analyst and the Project

Joe Bourg is President and Founder of Millennium Energy, LLC and is lead project analyst for CSVP. He focuses on utility solar program design and evaluation and solar project development support, including business model assessment.

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. Contact info@communitysolarvalueproject.com

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