TASC

ATTACHMENT A

Docket No. 14-035-114
February 6, 2014

Checklist of Key Requirements for a Thorough Evaluation of DSG Costs

- ☑ **Is lost revenue or utility costs the basis of the study?** For NEM studies, lost revenue is the standard (what the DSG customer would have otherwise paid the utility). For other studies and even some NEM studies, the cost to serve the DSG customer is addressed instead, which should lead to an inquiry in particular regarding allocation of capacity costs.
- ☑ **Assumptions about administrative costs must reflect an industrywide move towards automation.** With higher penetration, costs per DSG customer tend to decline, so administrative costs should assume automation of processes.
- ☑ **Interconnection costs should not be included.** If the DSG customer pays for the interconnection, this should not be included as a cost to the utility. As well, the utility's interconnection costs should be compared to national averages to determine whether they are reasonable.
- ☑ **Integration costs should not be based on unrealistic future penetration levels.** Studies tend to find minimal grid upgrade requirements at DSG penetrations below a few percent. Looking ahead to what the grid might need to accommodate 50% penetration unnecessarily adds costs that are not actually being incurred.

VI. Conclusion

Valuations vary by utility, but valuation methodologies should not. In this report IREC and Rabago Consulting LCC suggests a standardized approach for calculating DSG benefits and costs that we hope proves helpful to regulators as they embark on commissioning or reviewing valuation studies. Please see the mini-guide at the end of this report for a quick reference guide to the recommendations in this report.

IREC

REGULATOR'S MINI-GUIDEBOOK

Calculating the Benefits and Costs of Distributed Solar Generation

Valuations vary by utility, but valuation methodologies should not. IREC and Rábago Energy LLC suggest a standardized approach for calculating DSG benefits and costs in the white paper "A REGULATOR'S GUIDEBOOK: Calculating the Benefits and Costs of Distributed Solar Generation." We hope that this paper proves helpful to regulators as they embark on commissioning or reviewing valuation studies. Below is a high-level summary of the recommendations in the white paper. Please see the full report for more detail per section.

A. KEY QUESTIONS TO ASK AT THE ONSET OF A STUDY

Q1: WHAT DISCOUNT RATE WILL BE USED?

Recommendation: We recommend using a lower discount rate for DSG than a typical utility discount rate to account for differences in DSG economics.

Q2: WHAT IS BEING CONSIDERED – ALL GENERATION OR EXPORTS ONLY?

Recommendation: We recommend assessing only DSG exports to the grid.

Q3: OVER WHAT TIMEFRAME WILL THE STUDY EXAMINE THE BENEFITS AND COSTS OF DSG?

Recommendation: Expect DSG to last for thirty years, as that matches the life span of the technology given historical performance and product warranties. Interpolate between current market prices (or knowledge) and the most forward market price available or data that can accurately be estimated, just as planners do for fossil-fired generators that are expected to last for decades.

Q4: WHAT DOES UTILITY LOAD LOOK LIKE IN THE FUTURE?

Recommendation: Given that NEM resources are interconnected behind customer meters, and result in lower utility loads, the utility can plan for lower loads than it otherwise would have. In contrast, other DSG rate or program options involving sale of all output to the utility do not reduce utility loads, but rather the customer facilities contribute to the available capacity of utility resources.

Q5: WHAT LEVEL OF MARKET PENETRATION FOR DSG IS ASSUMED IN THE FUTURE?

Recommendation: The most important penetration level to consider for policy purposes is the next increment: what is likely to happen in the next three to five years. If a utility currently has 0.1% of its needs met by DSG, consideration of whether growth to 1% or even 5% is cost-effective is relevant, but consideration of whether higher penetrations are cost-effective can be considered at a future date.

Q6: WHAT MODELS ARE USED TO PROVIDE ANALYTICAL INPUTS?
Recommendation: Transparent input models that all stakeholders can access will establish a foundation for greater confidence in the results of the DSG studies. When needed, the use of non-disclosure agreements can be used to overcome data sharing sensitivities.

Q7: WHAT GEOGRAPHIC BOUNDARIES ARE ASSUMED IN THE ANALYSIS?
Recommendation: It is important to account for the range in local values that characterize the broader geographical area selected for the study. In some cases, quantification according to similar geographical sub-regions may be appropriate.

Q8: WHAT SYSTEM BOUNDARIES ARE ASSUMED?

Recommendation: It may also be appropriate to consider impacts associated with adjacent utility systems, especially at higher (above 10%) penetration levels of DSG. [82]

Q9: FROM WHOSE PERSPECTIVE ARE BENEFITS AND COSTS MEASURED?

Recommendation: We recommend that ratepayer and societal benefits and costs should be assessed.

Q10: ARE BENEFITS AND COSTS ESTIMATED ON AN ANNUALIZED OR LEVELIZED BASIS?

Recommendation: We recommend use of a levelized approach to estimating benefits and costs over the full assumed DSG life of 30 years. Levelization involves calculating the stream of benefits and costs over an extended period and discounting to a single present value. Such levelized estimates are routinely used by utilities in evaluating alternative and competing resource options.

B. DATA SETS NEEDED FROM UTILITIES

- ☑ The five or ten-year forward price of natural gas, the most likely fuel for marginal generation, along with longer-term projections in line with the life of the DSG
- ☑ Hourly load shapes, broken down by customer class to analyze the intra-class and inter-class impacts of NEM policy
- ☑ Hourly production profiles for NEM generators, including south-facing and west-facing arrays
- ☑ Line losses based on hourly load data, so that marginal avoided line losses due to DSG can be calculated
- ☑ Both the initial capital cost and the fixed and variable O&M costs for the utility's marginal generation unit

[82] Mills and Wiser point out that consideration of inter-system sales of capacity or renewable energy credits could mitigate reductions in incremental solar value that could accompany high penetration rates. *See* A. Mills & R. Wiser, *An Evaluation of Solar Valuation Methods Used in Utility Planning and Procurement Processes* (Lawrence Berkeley National Laboratory), LBNL-5933E, at p. 23, December 2012 (nt Processes energy credits could *available at* http://emp.lbl.gov/publications/evaluation-solar-valuation-methods-used-utility-planning-and-procurement-processes.

☑ Distribution planning costs that identify the capital and O&M cost (fixed and variable) of constructing and operating distribution upgrades that are necessary to meet load growth

☑ Hourly load data for individual distribution circuits, particularly those with current or expected higher than average penetrations of DSG, in order to capture the potential for avoiding or deferring circuit upgrades

Note: where a utility or jurisdiction does not regularly collect some portion of this data, there may be methods to estimate a reasonable value to assign to DSG.

C. RECOMMENDATIONS FOR ASSESSING BENEFITS

1. **The following benefits should be assessed:**
    1. Energy
    2. System Losses
    3. Generation Capacity
    4. Transmission and Distribution Capacity
    5. Grid Support Services
    6. Financial: Fuel Price Hedge
    7. Financial: Market Price Response
    8. Security: Reliability and Resiliency
    9. Environment: Carbon& Other Factors
    10. Social: Economic Development
2. **Energy benefits should be based on the utility not running a CT or a CCGT.** It is highly unlikely that DSG will offset coal or nuclear generation. Some combination of intermediate and peaking natural gas generation, with widely accepted natural gas price forecasts, should establish the energy value.
3. **Line losses should be based on marginal losses.** Losses are related to load and DSG lowers circuit loads, which in turn lowers losses for utility service to other customers. Average line losses do not capture all of the loss savings; any study needs to capture both the losses related to the energy not delivered to the customer and the reduced losses to serve customers who do not have DSG.
4. **Generation capacity benefits should be evaluated from day one.** DSG should be credited for capacity based on its Effective Load Carrying Capacity ("ELCC") from the day it is installed. If the utility has adequate capacity already, it may not have taken into account DSG penetration in its planning and overbuilt other generation; the DSG units that are actually operating during utility peaks should be credited with capacity value rather than a plant that is never deployed.
5. **T&D capacity benefits should be assessed.** If the utility has any transmission plans, then DSG is helping to defer a major expense and should be included. On distribution circuits, watch for a focus on circuits serving residential customers, which tend to peak in the early evening when solar energy is minimal. Circuits serving commercial customers tend to peak during the early afternoon on sunny days, and a capacity value should be recognized for them in the form of avoided or deferred investment costs.
6. **Ancillary services should be evaluated.** Inverters that can provide grid support are being mass-produced, and utility CEOs in the United States are calling for

their use; ancillary services will almost certainly be available in the near future. Modeling the benefits and costs of ancillary services can also inform policy decisions like those related to interconnection technology requirements.

7. **A fuel price hedge value should be included.** In the past, utilities regularly bought natural gas futures contracts or secured long-term contracts to avoid price volatility. The fact that this is rarely done now and that the customer is bearing the price volatility risk does not diminish the fact that adding solar generation reduces the reliance on fuels and provides a hedging benefit.

8. **A market price response should be included.** DSG reduces the utility's demand for energy and capacity from the marketplace, and reducing demand lowers market prices. That means that the utility can purchase these services for less, saving money.

9. **Grid reliability and resiliency benefits should be assessed.** Blackouts cause widespread economic losses that can be reduced or avoided in some situations with DSG. As well, customers who need more reliable service than average can be served with a combination of DSG, storage and generation that is less expensive than the otherwise necessary standby generator.

10. **The utility's avoided environmental compliance and residual environmental costs should be evaluated.** DSG leads to less utility generation, and lower emissions of NOx, SOx and particulates, lowering the utilities costs to capture or control those pollutants.

11. **Societal benefits should be assessed.** DSG policies were implemented on the basis of environmental, health and economic benefits, which should not be ignored and should be quantified.

D. RECOMMENDATIONS FOR ASSESSING COSTS

1. **Determine whether lost revenue or utility costs are the basis of the study.** For NEM studies, lost revenue is the standard (what the DSG customer would have otherwise paid the utility). For other studies and even some NEM studies, the cost to serve the DSG customer is addressed instead, which should lead to an inquiry in particular regarding allocation of capacity costs.

2. **Assumptions about administrative costs should reflect an industry-wide move towards automation.** With higher penetration, costs per DSG customer tend to decline, so administrative costs should assume automation of processes.

3. **Interconnection costs should not be included.** If the DSG customer pays for the interconnection, this should not be included as a cost to the utility. As well, the utility's interconnection costs should be compared to national averages to determine whether they are reasonable.

4. **Integration costs should not be based on unrealistic future penetration levels.** Studies tend to find minimal grid upgrade requirements at DSG penetrations below a few percent. Looking ahead to what the grid might need to accommodate 50% penetration unnecessarily adds costs that are not actually being incurred.

TASC

ATTACHMENT B

Docket No. 14-035-114
February 6, 2014

The Alliance for Solar Choice
Witness Nathanael Miksis
Docket No. 13-035-184
Exhibit C

THE ALLIANCE FOR SOLAR CHOICE

Relevant Values of Solar Distributed Generation and Recommended Definitions and Methodologies

The list below groups costs and benefits based on how most studies treat each. Grid support/ancillary services has its own category since these distributed generation ("DG") attributes can either be a positive or negative value. In addition, the list provides a definition for each element and indicates the best process or methodology to assign a monetary value to each stated value. Rather than include detailed explanations of these processes and methodologies, we provide, where appropriate, references to sources with more complete explanations.

Ancillary Services and Grid Support

Value Category	Subcategories	Definition	Methodology / Process
Ancillary Services and Grid Support	-Ancillary Services -Reactive Supply & Voltage Control -Frequency Regulation -Energy imbalance -Operating Reserves -Scheduling and/or Forecasting -DG System Integration Costs -Technology Synergies	Ancillary services and grid support enable the reliable operation of a grid hosting customer-sited, distributed solar. The value of ancillary services and grid support can be either a positive or negative value when compared with the costs that would otherwise be incurred without distributed solar. Such services include reactive supply, voltage control, frequency regulation, energy imbalance, operating reserves and scheduling/forecasting. TASC believes that the value of "technology synergies", such as advanced inverter technology, or the combination of rooftop solar and energy storage, would also be accounted for here.	Model ancillary services benefit and costs. Regulator's Guidebook at 29-30 and 39-40.[1] Can be a benefit if the utility's ancillary service needs are a function of load. See E3 and Crossborder studies of NEM in California, included in Exhibit AS-1. Easier to quantify in markets where ISOs operate visible ancillary service markets.

1 Keyes, Jason B., Rábago, Karl R., Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation, Interstate Renewable Energy Council, Inc. and Rábago Energy, LLC, October 2013. Available at http://www.irecusa.org/wp-content/uploads/2013/10/IREC_Rabago_Regulators-Guidebook-to-Assessing-Benefits-and-Costs-of-DSG.pdf

Grid-Related Values

Value Category	Subcategories	Definition	Methodology / Process
Avoided Energy Costs	-Avoided Fuel / Purchased Power Costs -Avoided Variable O&M	The cost of energy that would have otherwise been generated to meet customer needs.	Determine future market price of energy over the lifetime of the distributed solar facility. Regulator's Guidebook at 21-22.
Avoided Energy Losses	-Avoided Line Losses	The value of the additional energy generated by central plants that would otherwise be lost due to inherent inefficiencies in delivering energy to the customer via the transmission and distribution system.	Compare total line losses without distributed solar to total line losses with distributed solar. Regulator's Guidebook at 23-24.

Value Category	Subcategories	Definition	Methodology / Process
Avoided Capacity Costs for Generation	-Avoided Power Plant Capital Costs – Customer's Capital Contribution -Avoided Fixed O&M -Avoided Power Plant Decommissioning Costs -Distributed Energy Capacity Value -Avoided Generation Capacity (new generation $) -PV System Orientation	The cost and amount of generation capacity that can be deferred or avoided due to distributed solar. The orientation of a PV system will affect the amount of capacity that distributed solar provides. In turn, the amount of capacity distributed solar provides will directly impact the avoided need for new generation capacity. The value of the avoided need for new generation capacity includes avoided capital costs, avoided fixed O&M, and avoided decommissioning costs.	Determine the capacity value of distributed solar using the Effective Load Carrying Capacity methodology. Regulator's Guidebook at 24-26. Control area operators may have comparable procedures for setting the resource adequacy capacity of distributed solar resources. Determine the capital and O&M costs of the marginal generator that is avoided. Regulator's Guidebook at 24-26.
Avoided and Deferred Capacity Costs for T&D	-Avoided / Delayed Transmission System Investment -Avoided / Delayed Distribution System Investment	The value of the avoided or deferred T&D infrastructure investments due to distributed solar.	Use location-specific data to conduct individualized assessment of distributed solar system value. Regulator's Guidebook at 26-29. Important to consider long-term avoided costs, beyond the utility's near-term T&D plans.

Value Category	**Subcategories**	**Definition**	**Methodology / Process**
Avoided Renewables Costs	-Avoided Renewable Energy and Energy Efficiency Portfolio Standard (REPS) Costs	When customer-sited, distributed solar generation reduces onsite load, a utility does not have to procure as much renewable generation capacity to meet renewable portfolio standards. This reduction in procurement obligations results in cost savings. Customer-owned distributed solar satisfies customer demand to be served with a penetration of renewable generation in excess of the utility's RES requirements, and thus can avoid the costs which the utility would incur to meet such customer preferences through green pricing programs or other initiatives.	Quantify reduction in REPS compliance costs and calculate against market price for the relative compliance instrument. Regulator's Guidebook at 32-35. Customer demand for a higher-than-REPS share of renewables can be valued based on the cost of utility "green pricing" programs which serve the same customer demand. The U.S. Department of Energy maintains a data base of such programs.[2]
Fuel Price Hedge	-Avoided Fuel Hedging Costs	The avoided costs a utility would otherwise incur to guarantee energy fuel costs are fixed.	Compare the cost of a 30-year investment with substantial price uncertainty to one with a fixed price. Regulator's Guidebook at 30.

2 EERE, U.S. DOE, Green Pricing: Utility Programs by State, http://apps3.eere.energy.gov/greenpower/markets/pricing.shtml?page=1 .

Value Category	Subcategories	Definition	Methodology / Process
Energy Market Impacts	-Avoided Market Price Mitigation (reduction of wholesale market clearing prices for natural gas and electricity)	Distributed solar reduces the demand for fuel to power central station generators and for wholesale power in the wholesale electricity market, reducing wholesale market clearing prices for natural gas and electricity. Reduced demands in these markets lowers prices across the entire market served, providing benefits for the general body of consumers who use these markets.	Estimate the difference between current price projections and hypothetical price projections without the reduction in demand caused by distributed solar. Regulator's Guidebook at 31. Easiest to calculate for regions with deregulated markets and visible market prices. For example, this benefit is regularly included in avoided cost calculations in the U.S. Northeast.[3] These benefits in the natural gas market also have been quantified.[4]

Environmental Values

[3] The market price mitigation benefit of demand-side resources, also called the demand reduction induced price effect (DRIPE), has been estimated at 19-25% of combined energy and capacity prices. Synapse Energy Economics, "Avoided Energy Supply Costs in New England: 2011 Report" (August 11, 2011), at Exhibit 1-1. Available at http://www.synapse-energy.com/Downloads/SynapseReport.2011-07.AESC.AESC-Study-2011.11-014.pdf .

[4] A Lawrence Berkeley National Lab study estimated that the consumer gas bill savings associated with increased amounts of renewable energy and energy efficiency, expressed in terms of $ per MWh of renewable energy, range from $7.50 to $20 per MWh. Wiser, Ryan; Bolinger, Mark; and St. Clair, Matt, "Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency" (January 2005), at ix, http://eetd.lbl.gov/sites/all/files/publications/report-lbnl-56756.pdf.

Value Categories	**Subcategories**	**Definition**	**Methodology / Process**
Environmental Benefits	-Water Consumption -Cost of Environmental Compliance	The saving realized from reduced air emission control or allowance costs, including those related to carbon, criteria air pollutants and reduced water use.	To the extent not reflected in the cost of avoided energy, quantify the reduction in carbon, criteria air pollutants, and water use, and calculate using the market price for the appropriate compliance instrument (such as the price of carbon offsets). Regulator's Guidebook at 32-35.

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Societal Values

Value Categories	Subcategories	Definition	Methodology / Process
Health Benefits	-Health Effects (Benefits)	The reduction in societal costs from health risks, including reduced morbidity and mortality, related to air pollution from fossil-fuel production, transportation, and generation.	Quantify reduction in carbon or criteria air pollutants and calculate against estimates of the cost of impacts from such pollution in public health studies. Regulator's Guidebook at 32-35.
Security and Resiliency of the Electric Grid	-Grid Security -Grid / Service Reliability	The benefits to society (*i.e.*, the economy) realized from: (1) The reduction in outages from reduced congestion along the T&D network, (2) The minimization of large-scale outages resulting from a more diverse and dispersed electricity supply, and (3) Back-up power provided by customer-sited DG.	Compare assumed risk of outages and blackouts, assumed cost to strengthen grid to avoid that risk, and assumed ability of DG to strengthen the grid. Regulator's Guidebook at 31. This benefit has been calculated for DG in several Mid-Atlantic states.[5]

[5] Hoff, Norris, and Perez, *The Value of Distributed Solar Electric Generation to New Jersey and Pennsylvania* (November 2012), at Table ES-2, available at http://mseia.net/site/wp-content/uploads/2012/05/MSEIA-Final-Benefits-of-Solar-Report-2012-11-01.pdf.

Value Categories	**Subcategories**	**Definition**	**Methodology / Process**
Avoided Environmental and Safety Costs	-Non-Compliance Environmental Effects	The reduction in costs related to: (1) Fewer land use impacts because customer-sited, distributed solar is installed in the already-built environment; (2) The savings realized from avoided accidents, pollution and economic loss associated with the extraction, transportation, distribution, and processing of fossil fuels; and (3) The reduced compliance costs related to a decrease in the extraction, transportation, distribution and proceeding of fossil fuels.	Difficult to calculate, although the cost of specific accidents can be very large.
Effects on Economic Activity and Employment	-Economic Development and Jobs	The value from the increase in jobs and local economic development related to customer-sited, distributed solar and the resulting increase in welfare and economic productivity of children and working adults from the above health benefits.	Calculate tax enhancement value from derived from DG industry in the state. Regulator's Guidebook at 35.
Visibility Benefits		The increased recreation value and economic activity associated with improved visibility due to emissions reductions from power generation.	Assess using environmental impact analysis methodology.[6]

[6] *See, e.g.,* "The Benefits and Costs of the Clean Air Act from 1990 to 2020", Office of Air and Radiation, U.S. Environmental Protection Agency, p. 18 (March 2011) (available at http://www.epa.gov/oar/sect812/feb11/summaryreport.pdf).