

Distributed Energy and Net Metering Technical Conferences

May 28, 2013 CLOSING FORUM



Participation Processes



✓	Opening Forum Creating a common set of expectations	February 21, 2013
	Workshops Detailed examination of the methodologies	
✓	I. Understanding Rates and DE Benefits	March 7, 2013
✓	II. Resource Planning and DE Costs	March 20, 2013
✓	III. SAIC Study and Other Models	April 11, 2013
✓	IV. Other Policy and Valuation Perspectives	May 9, 2013
➔	Closing Forum	May 28, 2013

Agenda – Closing Forum



- 1:00 Welcome** **Bob Davis, *nFront Consulting***
Thank You, Jeff Guldner, APS Senior Vice President
Review of Forum Purpose and Goals
- 1:15 Review of Technical Conferences** **Bob Davis, *nFront Consulting***
Presentation Summaries
Key Topics and Issues
Major Insights and Perspectives
Discussion
- 2:45 Break**
- 3:00 Final Cost Benefit Matrix** **Bob Davis, *nFront Consulting***
Review of Cost Benefit Matrix
Summary of Perspectives
Areas of Agreement and Disagreement
Discussion
- 3:45 Closing and Final Discussions**
- 4:00 Adjourn**



Thank You
Jeff Guldner, Senior Vice President
Arizona Public Service Company



The following presentation paraphrases information and discussion presented at individual technical conference workshops and is not to be read as a summary of the results of the forum.

Arizona Corporation Commission Order



As part of the Arizona Public Service Company Renewable Energy Standard (RES) 2013 Implementation Plan deliberations on January 23, 2013, the Arizona Corporation Commission ordered APS to “conduct a multi-session technical conference to evaluate the costs and benefits of Distributed Renewable Energy and Net Metering.”

These conferences will evaluate costs and benefits of distributed energy to both renewable and non-renewable customers, and will consider such issues as environmental mandates, changes in generation requirements from distributed energy, localized grid impacts, system losses, and other relevant topics.

Forum and Workshop Goals



- Meet Arizona Corporation Commission expectations
- Create stakeholder collaboration
- Focus activities on education and engagement
- Develop common understanding of issues and options as we work through solutions
- Create an understanding of critical challenges



Review of Technical Conferences



Opening Forum February 21, 2013

Opening Forum



- Welcome by Jeff Guldner, APS Senior Vice President
 - APS goals and critical challenges for adding distributed energy
 - Purpose and goals of technical conferences
 - Costs and benefits to renewable and non-renewable customers
- Mark Gabriel
 - Goals and process
 - Develop a common understanding of the issues, options and challenges
 - Alignment

Opening Forum (cont.)



- Stakeholder Perspective on Workshop Goals and Subject Matter
 - Identify costs and benefits DE (comprehensive)
 - Best practices for cost-benefit studies
 - Need transparent, data-driven process
 - Use industry studies
 - Consideration of energy storage
 - Fossil and nuclear subsidies
 - Stakeholder agreement with and involvement in studies
 - Stakeholder access to data sources used in cost-benefit studies
 - Retail rate fairness and equity, rate stability, long-term rate impacts, ratepayer value

Opening Forum (cont.)



- Stakeholder Perspective on Workshop Goals and Subject Matter(cont.)
 - Inadequacy of current rate design
 - Cost-effectiveness perspectives (rate impact measure, RIM)
 - Drive technology innovation and new business models
- Issues that may not be addressed by technical conferences
 - Need for R&D, pilot studies, new approaches
 - Create a sustainable industry future for DE in AZ
 - Qualified solar installer program
 - Consumer education when purchasing DE
 - Retail rate transparency
 - Commission involvement in the process
 - Value of storage in the cost-benefit study

Opening Forum (cont.)



Net Metering Overview, Eran Mahrer, SEPA

- Dramatic issues and unprecedented opportunities
- Changing customer demands - regulatory models require adaptation
- Net-metering is widely available
 - Utilities in over 43 states offer net-metering
 - Easily explained to customers
- Rate impact may not match utility costs and benefits
 - Power export and energy efficiency impacts
 - Current net-metering rate models do not recover fixed costs
 - Customer bill reductions/refunds exceed utility avoided costs
 - Provides poor market signals to DE customers and industry

Opening Forum (cont.)



Net Metering Overview, SEPA (cont.)

- Net-metering design, two camps:
 - Net-metering works, don't change it
 - Reevaluate net-metering to provide equitable cost distribution and full cost recovery
- Possible net-metering redesigns:
 - Demand based rates
 - Simple, already in use with large customer rate classes
 - Net cost of service to serve DE customer
 - Analytically complex
 - Value of solar (consumption and production are separate)
 - Consumption at standard rates
 - Production at avoided costs



Net Metering Overview, SEPA (cont.)

- Many value attributes of DE are long-term
- Even with equal long-term value, near-term impacts to ratepayers are not equal
- Recommendations discussed:
 - Quantify value of DE
 - Establish transaction model that supports DE and customers
 - Maintain simplicity
 - Minimize the need for subsidies
 - Maintain recovery of utility costs

Opening Forum (cont.)



APS Perspective, Greg Bernosky, Renewable Energy Mgr.

- Customers changing how they consume (and produce) energy
 - Solar DE is available to a greater number of customers
- APS response
 - Maintain safe and reliable power supply
 - Recover infrastructure invest and operating costs
 - Modernize rate design to manage cost impacts for both DE participants and non-participants
- Billing offsets should match utility net avoided costs of DE
 - Identify unbundled costs of service
 - Identify role of incentives or subsidies, if any
 - Make solar DE sustainable through new rate design

Opening Forum (cont.)



- Introduction to future technical conference subjects
 - Retail rate making
 - Revenue requirements determination
 - Unbundled cost of service determination
 - Rate design development
 - Integrated resource planning
 - Avoided operating costs
 - Delayed or avoided facility investments
 - Possible cost increases
 - Utility load shape impacts
 - SAIC refresh of RW Beck 2009 DE Study
 - Refresh of 2009 RW Beck study
 - Discussion of major changes to key assumptions
 - Review of data sources

Opening Forum (cont.)



- Summary of Stakeholder Q&A and general comments:
 - Net metering is not broken and does not need to be fixed
 - Output of the process should be a comprehensive cost-benefit study
 - Various natural gas price and environmental scenarios should be considered as part of the SAIC study
 - Concerns that single-axis tracking PV, various PV orientations, and solar water heating will not be part of the SAIC study
 - Interest in expanding the schedule for the technical conferences to permit stakeholders the chance to direct the study approach and to participate in SAIC analysis and modeling
 - Stakeholders were asked to develop a list of costs and benefits categories for inclusion in the SAIC study



Workshop I

Understanding Rates and DE Benefits

March 7, 2013

Workshop I



- Workshop Opening, Review of Stakeholder Goals, and Alignments
- Preliminary overview of SAIC refresh study process
 - Review of data sources and request for comments and suggestions
 - Review of key assumptions
- Summary of stakeholder Q&A:
 - APS data on monitored solar PV is being utilized in the study
 - Stakeholders will have access to the APS solar data
 - Stakeholders will be provided the data being provided to SAIC, to the extent possible
 - The SAIC results will be reviewed in a manner to provide transparency
 - SAIC will utilize PROMOD simulations of the APS system
 - SAIC will validate PROMOD input assumptions
 - SAIC will validate that PROMOD results are consistent with expectations and experience
 - The PROMOD model will not be benchmarked to market price data
 - SAIC will modify model inputs to perform sensitivity analyses

Workshop I (cont.)



- Summary of stakeholder Q&A (cont.):
 - The PROMOD modeling will use hourly solar load shapes
 - The value of DE on avoided capacity is included in the study
 - The SAIC study will be expanded to include results for 2020 (in addition to 2015 and 2025)
- Summary of stakeholder general comments:
 - Study needs to consider scenarios that incorporates technology and fuel market variations
 - Solar water heating should be included in the study
 - Stakeholders have not received the same access to data assumptions/inputs as SAIC [APS noted that SAIC had not yet received the full data set at the time of the workshop. Additionally, the workshops schedule was extended to provide the stakeholders more time.]
 - The study should reflect the utility capacity avoided by existing DE installations
 - Modeled solar implementation should include scenarios of two- and four-times current implementation levels

Workshop I (cont.)



- Additional data considerations (Tom Beach for SEIA)
 - Market price mitigation
 - Benefits from southwest or west facing orientations of fixed arrays
 - Grid security benefits
 - Fuel hedge value
 - Environmental compliance savings
 - Reliability benefits
 - Environmental savings (like water)
 - Avoided RPS wholesale purchases
- APS is reviewing these additional data considerations and will address at a future date

Workshop I (cont.)



Utility Rate Making, Tony Georgis, New Gen Strategies and Solutions

- Primary steps in rate-making:
 - Determine revenue requirements
 - All reasonable expenses, cost of capital, taxes, and fair rate of return
 - Test year analysis
 - Known and measurable adjustments
 - Allocate costs:
 - Functionalize costs (production, transmission, distribution, etc.)
 - Classify costs (demand, energy, customer costs, etc.)
 - Allocate costs among rate classes (load shapes, coincident/non-coincident demand, etc.)
 - Design rates
 - Cost curves
 - Objectives
 - Rate components

Workshop I (cont.)



Utility Rate Making, Tony Georgis (cont.)

- Subsidization
 - Intra-class subsidization
 - Inter-class subsidization
- APS current costs and rate structures
 - Alignment of variable and fixed costs and revenue
 - Unbundled rate components
 - Adjustments
- Summary of stakeholder Q&A and general comments:
 - Lack of alignment of fixed and variable costs and revenue is not caused by solar DE, but solar DE makes the problem worse
 - For commercial customers, fixed and variable alignment is not as big a problem, but variations in load factor cause subsidization
 - When using a historical test year, rates are designed to cover historical, not forecast, costs (Arizona does not allow a forward-looking test year)
 - Rates are set based on embedded costs, not marginal costs
 - When computing rates, non-coincident demand is used to measure the facilities required to meet the demand of the customer when DE is not operating.

Workshop I (cont.)



APS Rates Overview and Impact of Solar DE, Charles Miessner, APS

- APS major rate classes
 - Types, customer, energy and revenue allocations by class
- Billing elements and charge types
 - Fixed charges, variable charges, and mixed (tiered rates)
 - Bundled and unbundled components
 - Adjustments
- APS specific rate designs and DE bill savings
 - Example DE billing component savings
 - Example utility cost savings
- Conceptual discussion of cost-shifting *billing gap* issue
 - Cost equity test (utility cost savings = bill reductions, then no adverse impacts)
 - Billing gap (utility cost savings < bill reductions, then costs shifted to non-participants)
 - LFCR used to collect fixed costs from all customers, does not correct cross-subsidization



APS Rates Overview, Charles Miessner (cont.)

- Review of Navigant Study
 - Characterize cost shifting and rate impacts of DE
 - Evaluate potential cost equity issues
 - Assess compatibility of APS rates for rapidly growing DE
 - Study was not a cost-benefit analysis, IRP, evaluation of utility financing/earnings, or quantification of impacts on all customers
- Major Findings
 - Under current rate designs, DE shifts costs to nonparticipating customers
 - Current APS rate designs are not sustainable with a growing level of DE
 - Net-metering exacerbates cost shifting
 - Cost shifting is highest for residential and small business customers because the rates rely on kWh charges for fixed cost recovery



APS Rates Overview, Charles Miessner (cont.)

- Summary of stakeholder Q&A and general comments:
 - Navigant study missed important benefits. Benefits are to be addressed by the SAIC study.
 - Navigant study utilized actual metered solar DE, applied to representative customers, to investigate sensitivity of cost equity to key assumptions
 - The study focused on rates classes with the greatest potential for cost shifting, other rate classes were not studied
 - Study focused on current impacts, not long-term benefits. Both costs and rates grow over time, so problem will persist.
 - Other known types of rate subsidies have already been vetted in rate cases; subsidies caused by DE has not yet been vetted
 - Total subsidies caused by DE are small today but are expected to grow significantly over time



APS Rates Overview, Charles Miessner (cont.)

- Summary of stakeholder Q&A and general comments:
 - Similar cost shifting issues exist for energy efficiency and conservation, but the level of cost shifting per participant is lower
 - Cost savings are based on installed assets, not future avoided costs
 - APS may receive RES credit for DE, which provides a benefit to APS
 - If benefits exceed costs, then subsidization is reversed
 - The billing gap for APS is approximately 15 cents, higher than referenced in the 2009 RW Beck Study, largely due to falling natural gas costs
 - The Navigant study did not consider costs for DE integration
 - Solar DE acts as a hedge against future natural gas prices, but doesn't eliminate all risks and may shift risk exposure from market volatility to fixed obligation
 - Large numbers of DE installations improves diversity and reliability



Workshop II

Resource Planning and DE Costs

March 20, 2013

Workshop II



- Workshop Opening and Review of Workshop I
- Alignments (from Workshop I and II)
 - Transparency is critical
 - Subsidies for all fuel sources should be considered
 - Additional studies, in addition to the Beck study, should be considered
 - Consumer education is important
 - There is a need for continued consideration of new applications
 - Definition of net-metering (see meeting notes)
 - DE rate impacts can occur through behind the meter rate offsets (self supply) as well as net metering bill credits
 - APS rates are based on historical test years
 - DE impacts both costs to serve and revenues collected
 - DE customers have a unique load profile, benefits, and costs

Workshop II (cont.)



- Not aligned
 - There should be a level playing field among distributed energy technologies
 - Current rate design may not be compatible with distributed energy
 - Rates need to consider impacts of DE participants and non-participants, while supporting utility cost recovery
 - Solar energy provides economic development opportunities for AZ
 - APS service is highly driven by fixed costs
 - For residential and small commercial rate categories, there is a mismatch between cost types and charge types (causation vs. recovery)

Workshop II (cont.)



Evaluating the Benefits and Costs of Net Energy Metering in California, Tom Beach, SEIA/Crossborder Energy

- Net energy metering (NEM) is simple and easy for customers to understand
- Impacts of NEM on non-participating customers is complex
- Under PURPA, customers have rights to interconnect, offset their own load, and receive avoided cost payments for exports to the grid
- Does NEM rate credit accurately capture the value of exported power
- NEM evaluations should use the same approach used to evaluate demand-side resources
- Cost-effectiveness of NEM (net export) and DE (all DE production) are not the same
- NEM cost-effectiveness should be performed using the RIM test (California uses the TRC test)
- NEM from DG is a long-term resource (long-term costs and benefits)
 - Costs - lost revenue, integration costs, incremental administration,
 - Benefits - avoided generation costs (energy and investment), avoided environmental, RPS value, avoided T&D investment, avoided losses

Workshop II (cont.)



Evaluating the Benefits and Costs of Net Energy Metering, Tom Beach/SEIA (cont.)

- Common misconception is that NEM credits result in customers that do not pay for certain utility services
 - NEM exports are more valuable than the average cost of generation credited through rates
 - Power exported by NEM customers should be treated similar to generators, who do not pay for power delivery (recipient of power pays delivery costs)
- PG&E has noted a 25 cent subsidy paid by non-participating residential customers
- 2009 E3 analysis forecast NEM subsidies at \$137/yr (0.4% of IOU revenues)
- Recent changes in forecast utility costs and rates, and values of offsetting RPS have resulted in lower subsidy levels

Workshop II (cont.)



Evaluating the Benefits and Costs of Net Energy Metering, Tom Beach/SEIA (cont.)

- Major categories of cost and benefits from CPUC-E3 study
 - Energy - all-in CCGT cost less CT capacity cost
 - Capacity - CT fixed cost (top 250 hours)
 - Avoided T&D losses
 - GHG allowances
 - Reduced ancillary services costs
 - T&D marginal capacity cost
 - Avoided RPS cost
 - 20-year levelized value of NEM solar exports exceeds cost of baseload energy

Workshop II (cont.)



Evaluating the Benefits and Costs of Net Energy Metering, Tom Beach/SEIA (cont.)

- Crossborder CA NEM Study
 - Same methodology as CPUC-E3 study
 - Evaluate value of NEM exports for bill credit and avoided utility costs
 - Compute for multiple bins of different customer size and PV system size
 - Conclusions:
 - Solar NEM has a positive net benefit (utility costs are reduced more than are paid through NEM rates credits)
 - Two of three CA IOUs show no cross-subsidization between residential participating and non-participating customers
 - All three IOUs show no cross-subsidization for C&I customers
 - Greater adoption of TOU rates reduces cross-subsidization

Workshop II (cont.)



Evaluating the Benefits and Costs of Net Energy Metering, Tom Beach/SEIA (cont.)

- Summary of stakeholder Q&A and general comments:
 - Integration costs are not included in the E3 model (CA has not adopted assumptions for integration costs)
 - Allowance costs are \$10-13 for 2013 in E3 model
 - Avoided T&D costs are based on regression methodology
 - Once RPS is met, DE will still have value through exports and likelihood of increasing RPS standards
 - Intermittency of individual DE is managed through aggregated installations; benefits may be lower on individual circuits
 - In the E3 model, solar DE capacity does not diminish with increasing installations
 - Other studies indicate a correlation between cloud cover and decreased demand, but effect takes hours to occur in AZ
 - The E3 model captures hedge cost value by using forward market prices

Workshop II (cont.)



Resource Planning & Distributed Energy, Bob Davis, nFront Consulting

- Electric utilities are responsible for providing reliable power at low cost
- Regulations may require utility-sponsored demand-side resources (energy efficiency, DE, etc.)
 - APS is currently planning to meet EE targets and is forecast to meet or exceed RE and DE targets
- Utilities will consider demand-side implementations if they pass certain benefit/cost tests (utility cost test, RIM test, TRC test)
- Solar DE impacts utility operations and planning
 - Changes generation dispatch (generally reduces operating cost, but can cause increase in operating costs during some periods)
 - Reduces need for future generation capacity additions
 - May incur costs to integrate solar DE

Workshop II (cont.)



Resource Planning & Distributed Energy, Bob Davis (cont.)

- Evaluation process (general description)
 - Develop solar DE load shapes and forecast implementations
 - Adjust load shapes for energy and demand losses
 - Compute dependable capacity for solar DE
 - Adjust for demand losses
 - Effective load carrying capability (ELCC)
 - Coincident with electric system peak
 - Diminishing capacity value with increasing penetration
 - Avoided capacity costs
 - Assess utility capacity additions with/without solar DE
 - Identify avoided or deferred generating units or capacity purchases (solar DE avoids similarly performing generating resources)
 - Capital costs of avoided or deferred generating unit addition and transmission interconnection
 - Other fixed O&M costs of avoided or deferred unit

Workshop II (cont.)



Resource Planning & Distributed Energy, Bob Davis (cont.)

- Evaluation process (cont.)
 - Compute avoided marginal energy costs
 - Generation dispatch simulation
 - Fuel costs, variable O&M, emission allowances, start-up costs
 - Simulation with and without solar DE
 - Compute avoided marginal costs
 - As larger quantities of solar DE are installed
 - More difficult to accommodate DE resources in the generation dispatch
 - Inefficient dispatch operations can result
 - If solar DE installations are not timed to match utility capacity additions, value of DE may be reduced
- Conclusions
 - Solar DE can avoid both energy and capacity related utility costs
 - Dependable capacity of solar DE is important
 - Solar DE benefits may be less than anticipated as a result of dispatch inefficiencies and timing of solar DE installations

Workshop II (cont.)



Resource Planning & Distributed Energy, Bob Davis (cont.)

- Summary of stakeholder Q&A and general comments:
 - APS is looking at small 100 MW increments of generation additions when evaluated avoided capacity costs
 - There is no industry-preferred model for analyzing capacity expansion
 - APS is using PROMOD to model energy costs, not market price modeling; DE may cause dispatch inefficiencies for APS that would not be reflected by a market price forecast
 - Discussion of whether DE production can be sold to a neighboring subdivision, thus eliminating the need for the LFCR mechanism; but APS would still need to provide facilities to serve 100% of the load sometimes
 - Large lumpy capacity additions eliminate capacity additions for a period of time following the addition; APS models both generating unit additions and purchased capacity to mitigate this effect

Workshop II (cont.)



Resource Planning & Distributed Energy, Bob Davis (cont.)

- Summary of stakeholder Q&A and general comments:
 - Discussion on timing of avoided costs is compelling; APS can only include actual costs in rate making, for example, future costs escalators in contracts cannot be monetized for rates today
 - ELCC is a rigorous way of looking at resource need
 - Economic benefits of solar orientation and single axis tracking is minimal
 - Surplus DE can help improve system reliability and mitigate loss of generating assets (example is nuclear unit in CA)
 - Stakeholders and APS disagree on whether to model “lumpy” capacity additions

Workshop II (cont.)



APS Resource Planning, Paul Smith, APS

- Review of APS future load growth and generating capacity need (2017)
- Solar DE energy value simulated using PROMOD IV
 - Detailed simulation of APS costs of generation dispatch
 - Total APS energy costs with and without solar DE
 - Operational challenges can occur during low load periods (ramp up, ramp down, scheduling for dual peaks, increased unit starts, intermittency, dump energy)
 - Integration costs
 - Predominant avoided energy is CC energy
- Key changes from 2009 RW Beck Study
 - APS load forecast (lower)
 - Solar DE implementation (higher)
 - Fuel prices, especially natural gas (lower)
 - CO2 prices (lower)
 - Capacity cost of new CT (higher)
 - Fixed O&M of new CT (higher)
 - NG reservation fee (higher)



APS Resource Planning, Paul Smith (cont.)

- Dependable solar DE capacity based on ELCC analysis
 - Industry best practice methodology
 - Probabilistic - solar DE capacity established over many peak hours not just peak hour
 - Dependable capacity decreases with increasing solar DE implementation
 - Incremental capacity value of future solar DE installations will be significantly less than value today



APS Resource Planning, Paul Smith (cont.)

- Review of additional data considerations
 - APS considerations
 - Must accrue real, measurable benefits to our customers
 - Impacts must be recognized in cost of service ratemaking
 - Test year versus future looking
 - Does not include societal benefits/externalities
 - Market price mitigation
 - Direct cost savings included in PROMOD modeling, indirect value is theoretically possible
 - NG market influence unclear
 - APS not in an LMP market
 - APS is both buyer and seller, uncertain net effect

Workshop II (cont.)



APS Resource Planning, Paul Smith (cont.)

- Review of additional data considerations
 - Grid security
 - Already addressed by ELCC analysis
 - Fuel hedge value
 - APS models forward price for NG (captures market view)
 - APS has 3-year hedge program (volatility diminished beyond 3-years)
 - Environmental compliance savings
 - Already included in PROMOD simulation
- Review of additional data considerations (cont.)
 - Reliability benefits
 - Spinning and operating reserves already model in PROMOD
 - Solar DE can increase requirements for ancillary services (ignored in APS analysis)
 - Avoided RPS purchases
 - No value above compliance
 - Value only for the net cost of RPS above conventional resources



APS Resource Planning, Paul Smith (cont.)

- Summary of stakeholder Q&A and general comments:
 - Diminishing value of solar DE capacity is produced as the system peak is pushed later in the day
 - Solar DE currently represents a small portion of the APS peak
 - New technologies (e.g., storage) may address some of the issues with diminishing capacity value; APS should consider only short-term forecasts, regular updates
 - Market price mitigation, even if small, should not be zero
 - APS is a net buyer of market energy
 - Emission savings are modeled as sensitivity cases in the IRP
 - Southwest/west orientation provide increased capacity value

Workshop II (cont.)



Stakeholder comments on initial draft of Cost Benefit Matrix

- Civic awareness should be added to the matrix
- Grid security should be added to the matrix
- Planning horizon with respect to new technologies is a challenge



Workshop III

SAIC Model and Other Studies

April 11, 2013

Workshop III



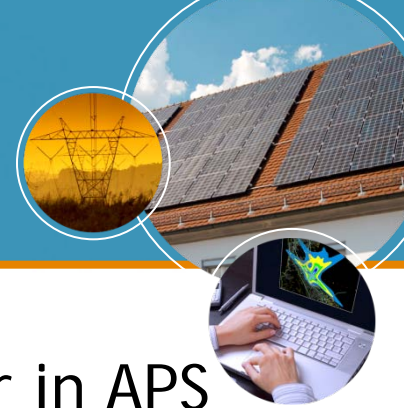
- Introduction of Bob Davis replacing Mark Gabriel as Workshop Facilitator
- Workshop Opening and Review of Workshop II
- Alignment, Bob Davis
 - Difficult alignment process is replaced with Cost Benefit Matrix
 - Will allow workshop participants to identify areas of agreement and disagreement
 - Categories and proposed descriptions were presented
 - Group of volunteers task with adding stakeholder perspectives to the matrix
- Summary of Stakeholder Q&A and comments:
 - The matrix will be presented in the final report
 - Suggestion to add Technology Synergies to the matrix
 - There are additional benefits for solar water heating

Workshop III (cont.)



- Energy Subsidies, Bob Davis
 - Topic of subsidies originated from discussion of retail rate subsidies
 - Presentation on Federal subsidies for the electricity industry
 - State-specific data difficult to develop/obtain
 - Summary of Stakeholder Q&A and general comments:
 - All fuel sources should be considered
 - Workshop participants uncertain how to reflect subsidies in the technical conferences and cost benefit study
 - Subsidies should be added to the Cost Benefit Matrix
 - Total subsidies of \$11B are approximately 4% of electric industry gross revenue
 - What are subsidy levels in current APS rates [APS provided in response to data request]
 - C&I solar DE customers provide a reverse subsidy
 - Renewable industries receive large subsidies because they are not yet mature
 - Federal subsidies are not relevant to ACC rate policies
 - Tax subsidy discussion is important; the sun is not taxed, other fossil fuel and generation receive subsidies
 - Renewables and clean technologies would be more competitive if ratepayers paid the true cost of energy from other sources

Workshop III (cont.)



- Applying DGValuator to Quantify Value of Solar in APS Service Territory, Tom Hoff, Clean Power Research
 - Benchmark DGValuator using SAIC study results
 - Produce range of values for various costs and benefits
 - Value of solar to utility
 - Value of solar to ratepayers and taxpayers
 - Review of other CPR studies
 - Austin Energy
 - Design solar tariff representing utility value of solar
 - PA and NJ MSEIA Study
 - Full value of solar (utility, ratepayers, taxpayers)

Workshop III (cont.)



Applying DGValuator, Tom Hoff (cont.)

- Methodology
 - Historical irradiation data
 - Utility value of solar
 - Fuel/energy - marginal cost of CCGT
 - Capacity - capital costs for CCGT
 - T&D capacity - average cost of long-run capacity upgrades
 - Environmental compliance - REC price
 - Fuel price hedge - cost to minimize fuel price uncertainty
 - Marginal losses by benefit category
 - Integration costs
 - Solar DE capacity developed using ELCC
 - Ratepayer and taxpayer value of solar
 - Economic development - net increase in jobs/tax revenues
 - Environmental value - future cost of environmental mitigation
 - Security enhancement - value of avoided outages
 - Market price reduction - price elasticity



Applying DGValuator, Tom Hoff (cont.)

- Summary of Stakeholder Q&A and comments:
 - Ratepayers don't pay for all modeled costs and benefits
 - Solar DE acts like a 30-year market price hedge; but utilities don't hedge for 30 years (too expensive); it is a policy question on whether to include hedging value
 - Value of solar for Austin (12.5 ¢/kWh) and MSEIA (30 ¢/kWh) are different based on value categories are included
 - T&D and reliability is examined on a system-wide basis
 - Uncertain how market price reductions apply to AZ; uncertain how to segregate transmission congestion effects from T&D deferrals
 - Market price reductions may affect other off-system sales
 - Funds spent in the local economy may have more economic benefit than funds spent by the utility



SAIC Distributed Energy Model and Analysis, Scott Burnham, SAIC

- 2013 Refresh Study
 - Leverage 2009 Study methodologies
 - Target years 2015, 2020, 2025
- Updated assumptions
 - Depict higher anticipated DE implementation
 - Lower NG prices
 - Lower CO2 prices
 - Lower Load forecast
 - Lower assumed demand and energy losses

Workshop III (cont.)



SAIC Distributed Energy Model and Analysis (cont.)

- Implementation scenarios
 - Low - Compliance
 - Expected - approximately twice compliance
 - High - approximately 4x compliance
- Avoided costs
 - Avoided energy
 - Avoided generation capacity and associated transmission
 - Deferral of distribution, sub-transmission, and transmission projects

Workshop III (cont.)



SAIC Distributed Energy Model and Analysis (cont.)

- Preliminary Results:
 - Deferral of distribution projects
 - Insignificant number of distribution feeders can be impacted
 - Deferral of Sub-transmission projects
 - Four projects can be deferred in target years for expected and high scenarios
 - No load-related transmission projects were identified for deferral
 - Avoided generation costs
 - Avoided energy costs (PROMOD) \$88M to \$290M (low to high case, 2025)
 - Avoided capacity costs \$30M to \$45M (low to high case, 2025)
 - Avoided transmission interconnection \$5M to \$8M (low to high case, 2025)
 - Total avoided costs (nominal \$)
 - 2015 - 3.2 to 3.5 ¢/kWh
 - 2020 - 6.6 to 8.0 ¢/kWh
 - 2025 - 6.5 to 10.0 ¢/kWh



SAIC Distributed Energy Model and Analysis (cont.)

- Summary of Stakeholder Q&A and comments:
 - Study analyzed the incremental value of new DE installations; existing installations were modeled but value was not computed for existing installations; rate design impacts on existing and incremental installations was not considered in this cost benefit study
 - Natural gas and CO2 price sensitivities were analyzed
 - Solar DE is modeled as forecast energy and demand impacts (not number of installations), therefore solar DE technology improvements could be captured by the study
 - Actual monitored DE production was used in the study
 - Losses were assumed to be constant and not vary by load or period
 - Reactive power provided by solar DE was not evaluated



SAIC Distributed Energy Model and Analysis (cont.)

- Summary of Stakeholder Q&A and comments:
 - Solar DE defers approximately 1/3 of planned distribution feeder upgrades
 - The PROMOD simulations were based on the latest APS IRP dataset
 - NG fuel price sensitivity is 30% higher, which captures market price increases since the NG price forecast was developed
 - Study evaluated the value of solar DE; the study did not consider the value of storage
 - Solar water heating was not studied; the most dramatic growth is in solar PV; solar water heating will be considered when APS presents its solution
 - Tom Hoff's presentation shows avoided energy costs of 10 ¢/kWh, while the SAIC study shows a value of 3 ¢/kWh; the 3¢ value is consistent with current NG prices and a CC heat rate; uncertain how Mr. Hoff's value is calculated
 - Should the study consider even lower implementation scenarios



Workshop IV Other Policy and Valuation Perspectives May 9, 2013

Workshop IV



- Workshop Opening
- Cost Benefit Matrix, Bob Davis
 - Latest edits
 - High-level summary of stakeholder perspectives
 - New categories
 - Summary of Stakeholder Q&A and comments:
 - Some DE technologies are missing; suggest adding perspectives for other technologies like solar water heating
 - Ratepayer cross-subsidization category seems one-sided; but definition reflects that subsidization can flow either way
 - Schools may have a unique load profile and rate impacts of DE; encouraged to participate in the cost benefit matrix
 - Ratepayer and consumer interests are important, but difficult to enumerate

Workshop IV (cont.)



A Perspective on the Benefits and Costs of Solar Distributed Generation for APS, Tom Beach, SEIA/Crossborder Energy

- Study overview
 - How solar DE impacts APS ratepayers
 - Evaluate DE not NEM
 - Use RIM test
 - 20-yr analysis
- Benefits (avoided costs)
 - Generation energy and capacity
 - Ancillary service & capacity reserves
 - Transmission and distribution
 - Environmental
 - Avoided Renewables
- Costs
 - Lost retail revenues
 - DG Incentives
 - Integration costs

Workshop IV (cont.)



Benefits and Costs of Solar DE, Tom Beach/SEIA

- Assumptions
 - NG price forecast similar to SAIC study
 - Avoided energy costs (Jun-Sep) - CT at 9,400 Btu/kWh
 - Avoided energy costs (other months) - CC at 7,300 Btu/kWh
 - Avoided capacity costs somewhat consistent with SAIC study
 - Ancillary services set to \$5/MWh
 - Capacity reserves modeled at 15%
 - Avoided T&D costs set to combination of assumptions from SAIC study and 2009 RW Beck study
 - Environmental costs set equal to APS IRP sensitivity cases
 - Value of avoided RPS based on APS IRP enhanced renewable portfolios
 - DE costs modeled as ~20 ¢/kWh for residential and ~10 ¢/kWh

Workshop IV (cont.)



Benefits and Costs of Solar DE, Tom Beach/SEIA

- Results (20-yr levelized)
 - Benefits 21.5 to 23.7 ¢/kWh
 - Costs 13.9 to 15.5 ¢/kWh
 - Benefit/cost ratio is 1.54
 - Benefits exceed costs from both residential and commercial classes
- Summary of Stakeholder Q&A and comments:
 - May be more germane to look at only NEM exports
 - Hourly dispatch was not modeled
 - On the APS system, CTs are run only a few hours per day in the summer, CC energy may be a better estimate of on-peak energy costs for APS; but, the energy prices used for the study are generally consistent with the Palo Verde market price
 - Generating capacity is assumed to be avoided in 2013
 - Study is computing the value of a 2013 DE installation and does not consider diminishing value of DE capacity with increased installations

Workshop IV (cont.)



Benefits and Costs of Solar DE, Tom Beach/SEIA

- Summary of Stakeholder Q&A and comments (cont.):
 - APS costs for ancillary services is about half of the rates that are used in the model
 - ELCC already incorporates the 15% capacity margin
 - When power exported from a DE resource is consumed by a neighbor, the utility does not have to invest in T&D because the power is flowing only a few feet; this is a misconception, DE resources only provide energy and do not provide all of the services provided by the utility; unless the neighbor disconnects from the grid and receives all services from the DE resource, the utility is still providing services; DE is diversified, as utilities become more familiar with DE resources, they will plan for fewer resources
 - The study used the 2009 RW Beck study for assumptions for avoided transmission costs because the SAIC study computed no avoided load-related transmission costs
 - Because existing installations are included in the study, shouldn't the historical cost of incentives also be included
 - It is appropriate to include the cost of incentives/rebates since these contribute to the program costs covered by ratepayers

Workshop IV (cont.)



Benefits and Costs of Solar DE, Tom Beach/SEIA

- Summary of Stakeholder Q&A and comments (cont.):
 - Lost retail revenue is modeled at 19.7 cents, instead of current rates at 15.5 cents; the value represents a 20-year levelized value
 - A net positive value in theory means APS could raise the level of incentives
 - Should avoided capacity be weighted by the allocation of avoided energy to different resource types; it's a matter of debate
 - The market price for Palo Verde represents the price for a firm product, not a product that varies hour to hour
 - The modeled natural gas pipeline reservation fee is 2-3 times higher than what APS actually incurs
 - Solar DE causes a pronounced double peak during non-summer days, which will impact the types of resources that APS needs to install to manage this load shape
 - Future storage technologies may positively impact the situation as well

Workshop IV (cont.)



Creating a Sustainable Solar Market, Chris Yunker, SDG&E

- SDG&E is creating a market structure that can accommodate market changes and customer choices for unbundled services
 - 33% renewable energy by 2020
 - Solar matches peak today, but will change and SDG&E need price signals to incentivize to meet the change
 - At 20% renewable, SDG&E already has surplus during some periods and must sell at a loss
 - Need rates and market structure to incentivize flexible capacity
 - Testing experimental EV and TOU rates
- Intermittent resources
 - Diversity is not sufficient to manage intermittency of renewable resources
 - Need to establish rate incentives for storage
 - Customers can buy service from the utility or install it themselves

Workshop IV (cont.)



Creating a Sustainable Solar Market, Chris Yunker (cont.)

- Unbundled services
 - Technology will cause customers to “unbundle” their needs
 - Utility must provide the correct unbundled price signals
 - Customers should pay a the correct rate when receiving a service and should be compensated at the correct rate when providing a service
 - Correct pricing should have nothing to do with subsidies needed to achieve policy goals
- Summary of Stakeholder Q&A and comments:
 - Since things are always changing, how can solutions be developed today; if prices and services are properly unbundled, they are flexible and can adapt to change
 - How do you make sure incentives are at the right level; incentives and rates should be transparent and unbundled; incentives created through rates are biased
 - Unbundled rates can be too complex for customers to understand; flat rate options can be offered that incorporate a hedge the customer pays

Workshop IV (cont.)



The Evolution of Net Metering, Rate Design and the Utility Business Model, Ron Binz, Public Policy Consulting

- Policy Objectives
 - Encourage solar
 - Diversify supply
 - Reinforce grid
- Rate design issues
 - Correct signal when price = marginal cost
 - But MC doesn't correctly compensate utility
 - Rate structure compromise
 - Complicated when customer is buyer and seller
- Unbundle tariff rate from DE payment (buy-all/sell-all model)
- Real issue is the evolving utility model, not distribution cost recovery under NEM

Workshop IV (cont.)



The Evolution of Net Metering, Rate Design and the Utility Business Model, Ron Binz (cont.)

- Utilities 2020
 - Utilities under pressure to change
 - Regulation may not be up to the task
 - Interviews with utility CEOs
 - Want clear energy policies
 - Little incentive for innovation
 - Certainty on climate change policy
 - Interviews with Commissioners
 - Primary focus is rates
 - Open to changing model, but inadequate resources
 - Dissatisfied with process and system
 - New regulatory models

Workshop IV (cont.)



The Evolution of Net Metering, Rate Design and the Utility Business Model, Ron Binz (cont.)

- Summary of Stakeholder Q&A and comments:
 - Solar has passed break-even threshold with natural gas
 - Long-run incremental cost is the most useful indicator for valuing capacity decisions
 - Accommodating customer choice and flexibility may require changing regulatory model from lowest cost to highest value

Workshop IV (cont.)



APS Conceptual Solutions, Chuck Miessner, APS

- APS has not made a decision on solutions
- Presentation of potential solutions
 - Rate design concept - better alignment of the value of solar DE with a solar-specific rate
 - Total DE concept - buy-all/sell-all
 - May need to address incentives
- Summary of Stakeholder Q&A and comments:
 - Concepts are to align value to costs so there is not subsidization either way
 - Buy-all/sell-all correctly captures the exchange
 - Buy-all/sell-all is different than end of year true-up
 - Consider offering both buy-all/sell-all and net metering
 - How will grandfathered rate/incentives be transferred to a new homeowner
 - Under buy-all/sell-all, customers do not get to reduce their use, become independent; the customer's net load is the same either way, but it is accounted for differently; the bill would still be credited

Workshop IV (cont.)



APS Conceptual Solutions, Chuck Miessner (cont.)

- Summary of Stakeholder Q&A and comments (cont.):
 - Customers are not billed at marginal costs, would result in different rates for different customers and may result in high rates
 - In buy-all/sell-all model, how do you project rates/credits over time, do they change simultaneously, how often do they need to be reviewed/set
 - Rates may be changed to remove embedded incentives and administered as a separate tariff
 - One solution under consideration by APS is something similar to the Austin plan
 - Will APS consider eliminating demand charges for schools and churches; this change would make the problem worse
 - Rate fluctuation for DE production makes it difficult to finance DE installations by driving up the cost of finance; rates change over time now, how much stability is needed 5, 10, 20 years
 - Why is net metering being singled out when other cost shifts are not; other subsidy issues are well know and have been vetted through the ACC, net metering and solar DE is not being singled out but instead needs to be vetted similar to the other subsidies

Workshop IV (cont.)



APS Conceptual Solutions, Chuck Miessner (cont.)

- Summary of Stakeholder Q&A and comments (cont.):
 - APS should consider sending education material on rates to customers applying for solar hookup
 - Marginal costs of new resources are more expensive than the embedded cost/rates, solar DE customers should be awarded for the marginal costs avoided; APS understands and is considering how and if it is possible to reflect future avoided costs through rates
 - Is it better for APS if customers disconnect from the electric system (with appropriate energy production and storage technologies) or continue to be served through net metering; APS would prefer to have customers so long as costs are being recovered
 - Has APS considered offering rates that provide lower levels of reliability; not in this proceeding
 - Question for financiers is what tolerance is needed around rate fluctuation; financing takes fluctuations into account and financiers can get comfortable with banded cash flow projections

Workshop IV (cont.)



APS Conceptual Solutions, Chuck Miessner (cont.)

- Summary of Stakeholder Q&A and comments (cont.):
 - In a buy-all/sell-all model, how do you police solar customers from diverting production prior to the meter
 - What are other utilities doing; Austin is considering separate rates for DE export, SDG&E is considering a more highly unbundled rate structure, Idaho Power is considering treating T&D costs as a demand charge, Dominion Power is implementing standby charges
 - How do we know a future facility will be avoided, what happens if future costs are not avoided but credits have been provided to DE customers
 - Does PURPA supersede enforcement of a buy-all/sell-all model, don't customers have the choice to sell only the excess; under PURPA, excess is sold at avoided cost, size of the customer and DE facility and annual production also affect the determination; net metering and PURPA are separate rulings
 - Need to consider whether a buy-all/sell-all approach results in tax considerations for the customer that are different than with self-serve and net metering



Cost Benefit Matrix



Closing and Final Discussions

Next Steps



- Meeting notes from Workshop IV have been posted
- Today's presentation has been posted
- Closing Forum meeting notes will be posted by June 7th
- Facilitator's Report will be posted by June 30th
- APS proposed solution filing with ACC in July

Thank You



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