



SolarCity

Evaluating the Economics of Distributed Energy Resources in Nevada

April 28th, 2016

*** Preliminary Results, Seeking Input***

Agenda

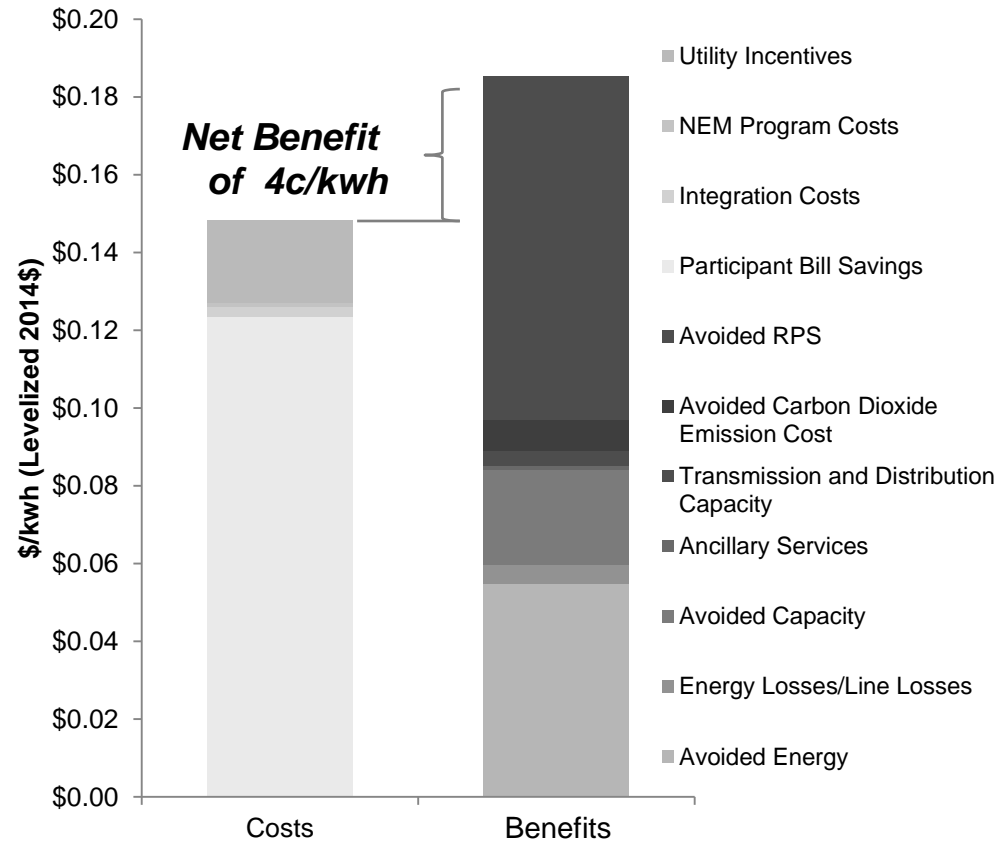
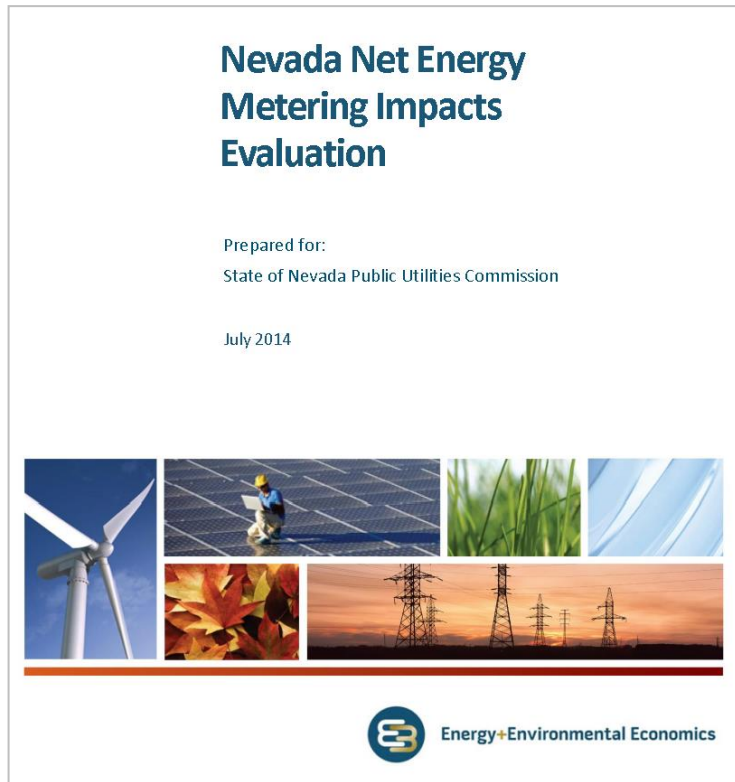
- Scope of PUC Nevada cost-benefit analyses
- SolarCity/NRDC cost-benefit analysis and methodology
- Incremental cost-benefits of future storage deployments

Comparing Scope of Benefits Considered

	E3 NEM Study (July 2014)	PUC NEM Order (Fall 2015)	PUC NEM Decision (Dec 2015)	PUC Order: Sierra Pacific IRP (April 2016)	RIM+ Assessment (Spring 2016)
Benefits	(1) Energy	(1) Energy	(1) Energy	(1) Energy	(1) Energy
	(2) Energy Losses	(2) Energy Losses	(2) Energy Losses	(2) Energy Losses	(2) Energy Losses
	(3) Gen Capacity	(3) Gen Capacity	(3) Gen Capacity	(3) Gen Capacity	(3) Gen Capacity
	(4) Ancillary Services	(4) Ancillary Services	(4) Ancillary Services	(4) Ancillary Services	(4) Ancillary Services
	(5) T&D Capacity	(5) T&D Capacity	(5) T&D Capacity	(5) T&D Capacity	(5) T&D Capacity
	(6) Criteria Pollutants	(6) Criteria Pollutants	(6) Criteria Pollutants	(6) Criteria Pollutants	(6) Criteria Pollutants
	(7) CO2 Emissions	(7) CO2 Emissions	(7) CO2 Emissions	(7) CO2 Emissions	(7) CO2 Emissions
	--	(8) Fuel Hedging	(8) Fuel Hedging	(8) Fuel Hedging	(8) Fuel Hedging
	Renewable Cert	(9) Environmental	(9) Environmental	(9) Environmental + Voltage Support + Fuel Supply Diversity	(9) Environmental Costs + Voltage Support / CVR + Market Price Suppression + Equipment Life Extension + Reliability and Resiliency
Costs	(10) Utility Integration	(10) Utility Integration	(10) Utility Integration	(10) Utility Integration	(10) Utility Integration
	(11) Utility Admin	(11) Utility Admin	(11) Utility Admin		(11) Utility Administration
	Participant Savings				Participant Bill Savings

Previous NEM Impacts Evaluation (2014)

Study prepared for Nevada PUC by Energy+Environmental Economics



Study found a 4 cent/kwh net benefit to all customers for NEM rooftop solar systems installed in 2014-2016

Source: http://puc.nv.gov/uploadedFiles/pucnv.gov/Content/About/Media_Outreach/Announcements/Announcements/E3%20PUCN%20NEM%20Report%202014.pdf?pdf=Net-Metering-Study

General Analytical Approach

E3 Nevada NEM Public Tool



Updated Inputs for 2016+



Nevada NEM Public Tool

Prepared by:

101 Montgomery Street, Suite 1600
San Francisco, CA 94104
(415) 391-5100

May 1, 2014

Contents:

User Interface:

User Inputs	Assumptions and inputs available for the user to modify
Results	Summary result charts and tables; user can specify result filters

Model Calculations:

Installations	Historical and forecasted installations by category and year
Capacity	Cumulative installed capacity by year (degraded and undegraded)
Energy Generation	Energy generation by category and year
Avoided Costs	Output from avoided cost calculator; avoided costs per kW installed by component and year
Avoided Costs by Component	Total avoided costs summarized by component
Bill Savings Inputs	Output from bill calculator; bill savings per kW installed by category
Annual Bill Savings	Total bill savings by category and year
Integration Costs	Integration costs by category and year
Program Costs	Program costs by category and year
Owner Costs	Output from pro forma financial calculator; owner costs by category and year
All Costs	All cost test components by category; summarized in 25 yr NPV format
NVE South RPS Value	Avoided RPS generation by NEM systems in NVE South
NVE North RPS Value	Avoided RPS generation by NEM systems in NVE North
2013 RPS Compliance Report Data	Historical and forecasted annual renewable energy production from NVE Energy RPS Compliance Report
Load Forecasts	Load forecasts used to calculate avoided RPS generation values

Color Schemes:

orange	User Input
gray	Fixed Input
white	Calculation

SIERRA PACIFIC POWER COMPANY dba NV Energy
6100 Neil Road
Reno, NV 89511
Tariff No. Electric No. 1

54 th Revised
53 rd Revised

PUCN Sheet No. 63G
PUCN Sheet No. 63G

STATEMENT OF RATES
EFFECTIVE RATES APPLICABLE TO SIERRA PACIFIC POWER COMPANY
ELECTRIC SCHEDULES
Bundled Rates

Schedule Number & Type of Charge	BTOR	BTFR	TRED	REPR	UEC	DEAA	EE	Total Rate
DS-1 - Domestic Service								
Basic Service Charge, per month								\$16.35
Consumption Charge per kWh	\$0.05793	\$0.03466	\$0.00105	(\$0.00422)	\$0.00039	(\$0.00673)	\$0.00198	\$0.08506 (R)
DM-1 - Domestic Multi-Family Service								
Basic Service Charge, per month								\$7.50
Consumption Charge per kWh	\$0.04862	\$0.03466	\$0.00105	(\$0.00422)	\$0.00039	(\$0.00673)	\$0.00184	\$0.07561 (R)
SS-1 - Small General Service								
Basic Service Charge, per month								\$16.35
Consumption Charge per kWh	\$0.05793	\$0.03466	\$0.00105	(\$0.00422)	\$0.00039	(\$0.00673)	\$0.00198	\$0.08506 (R)
SS-2 - Medium General Service								
Basic Service Charge, per month								\$16.35
Consumption Charge per kWh	\$0.05793	\$0.03466	\$0.00105	(\$0.00422)	\$0.00039	(\$0.00673)	\$0.00198	\$0.08506 (R)
SS-3 - Large General Service								
Basic Service Charge, per month								\$16.35
Consumption Charge per kWh	\$0.05793	\$0.03466	\$0.00105	(\$0.00422)	\$0.00039	(\$0.00673)	\$0.00198	\$0.08506 (R)

	RIM+ Assessment	Methodology
Benefits	(1) Energy	Utilized E3 tool, downward adjusting appropriate multiplier for energy avoided costs to capture the recent reduction in gas prices. Lowered original E3 energy avoided costs by 40% by looking at current (i.e. March 1 st , 2016) gas forwards. Gas forwards are 40-60% lower for 2016, 40% lower for 2017, 35% lower through 2020, and 25% lower through 2026. An average of 40% reduction incorporated in energy modeling to capture overall lower gas price forecasts.
	(2) Energy Losses	Utilized base E3 assumptions and methodology
	(3) Gen Capacity	Utilized base E3 assumptions and methodology. Note, however, that given lowered energy prices, value of avoided generation capacity is likely to increase in future years. However, these increased values were not incorporated into the analysis.
	(4) Ancillary Services	Utilized base E3 assumptions and methodology
	(5) T&D Capacity	Transmission: utilized base E3 assumptions; Distribution: incorporated E3's distribution capacity assumptions, which are based on NVE's marginal cost study from its most recent rate case.
	(6) Criteria Pollutants	Utilized base E3 assumptions and methodology
	(7) CO2 Emissions	Utilized base E3 assumptions and methodology. Allowance prices for Clean Power Plan based on NVE's estimate of carbon allowance prices from its recent Integrated Resource Plan. Prices based on CPP compliance starting in 2019.
Costs	(8) Fuel Hedging	TBD; Given lack of current financial hedging, benefit quantification is challenging.
	(9) Environmental costs	Calculated the levelized value for social cost of carbon based on the Environmental Protection Agency values. ¹
	+ Renewable Certificates	Original E3 methodology included credits; however, solar costs have come down significantly since 2014. Therefore, no incremental value for renewable energy certificates was included.
	+ Voltage and Power Quality	Utilized voltage and consumption data related to demonstration projects to quantify the value of the reduction of energy consumption and CO2 emissions from the use of PV smart inverters within conservation voltage reduction schemes.
	+ Market Price Suppression	In the absence of hourly wholesale market price data, the potential avoided cost from market price suppression is challenging to quantify. For reference, in California, the value of market price suppression was quantified to be [\$0.05 / kWh]. ² Given lower energy prices, the value of market price suppression is expected to be lower in Nevada albeit above zero.
	+ Equipment Life Extension	Utilized IEEE C57.12.00-2000 standard per unit life calculation methodology to quantify the increased life for medium to large liquid-filled transformers from typical load and DER generation profiles. ²
	+ Reliability and Resiliency	N/a; Reliability and resiliency benefits assumed to be realized from the addition of energy storage.
Costs	(10) Utility Integration	Utilized base E3 assumptions and methodology
	(11) Utility Administration	Utilized base E3 assumptions and methodology
	Participant Bill Savings	Update to current NVE retail rates ² . Utilize E3's lowest scenario for rate escalation: 0.5% escalation after 2019, instead of base assumption of 1.4%. 0.5% escalation is based on NVE's IRP projections through 2020.

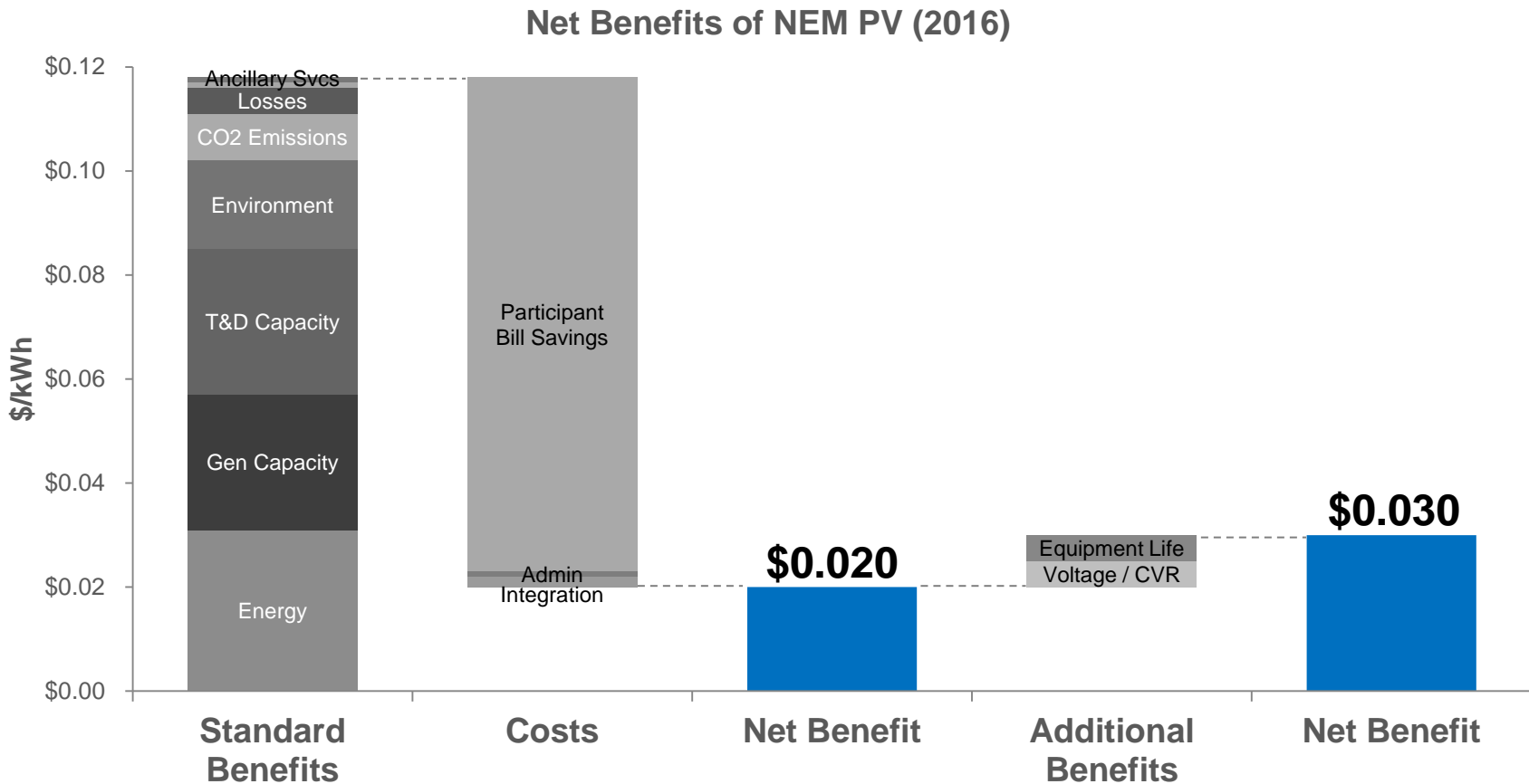
Scenarios Explored in Updated Analysis

1. *What is the net benefit to Nevada customers of leveraging NEM PV deployments, per the PUC Nevada cost/benefit specifications?*
2. *What is the net benefit to Nevada customers of leveraging portfolios of distributed energy resources, not just solar PV?*

Scenarios Modeled

Deployment Timeframe	Policy	Technology
2017-2019	Net Energy Metering	PV + Smart Inverters
2020-2022	Net Energy Metering with Mandatory TOU Rates	PV + Smarter Inverters + Energy Storage + Load Control

Preliminary Results: NEM PV drives net benefits for all Nevada customers



*** Preliminary Results, Seeking Input***

Preliminary Results

**** Preliminary Results,
Seeking Input****

	RIM+ Assessment	PV + Smart Inverters (2017-2019)	+ Storage & Load Control (2020-2022)
Benefits	(1) Energy	3.1 cents/kwh	
	(2) Energy Losses	0.5 cents/kwh	
	(3) Gen Capacity	2.6 cents/kwh	+++
	(4) Ancillary Services	0.1 cents/kwh	
	(5) T&D Capacity	2.8 cents/kwh	+++
	(6) Criteria Pollutants	0.1 cents/kwh	
	(7) CO2 Emissions	0.9 cents/kwh	
	(8) Fuel Hedging	TBD	
	(9) Environmental costs	1.7 cents/kwh	
	+ Voltage Support / CVR	0.5 cents/kwh	
	+ Market Price Suppression	TBD	
	+ Equipment Life Extension	0.5 cents/kwh	
+ Reliability and Resiliency	N/A	++	
Costs	(10) Utility Integration	0.2 cents/kwh	
	(11) Utility Administration	0.1 cents/kwh	
	Participant Bill Savings	9.5 cents/kwh	+
Net Benefit		>3.0 cents/kwh	TBD: Net Benefit

Detailed Methodology

E3 methodology used when available, with specified modifications

	Categories	Methodology
Benefits	(1) Energy	Utilized E3 tool, downward adjusting appropriate multiplier for energy avoided costs to capture the recent reduction in gas prices. Lowered original E3 energy avoided costs by 40% by looking at current (i.e. March 1 st , 2016) gas forwards. Gas forwards are 40-60% lower for 2016, 40% lower for 2017, 35% lower through 2020, and 25% lower through 2026. An average of 40% reduction incorporated in energy modeling to capture overall lower gas price forecasts.
	(2) Energy Losses	Utilized base E3 assumptions and methodology
	(3) Gen Capacity	Utilized base E3 assumptions and methodology. Note, however, that given lowered energy prices, value of avoided generation capacity is likely to increase in future years. However, these increased values were not incorporated into the analysis.
	(4) Ancillary Services	Utilized base E3 assumptions and methodology
	(5) T&D Capacity	Transmission: utilized base E3 assumptions; Distribution: incorporated E3's distribution capacity assumptions, which are based on NVE's marginal cost study from its most recent rate case.
	(6) Criteria Pollutants	Utilized base E3 assumptions and methodology
	(7) CO2 Emissions	Utilized base E3 assumptions and methodology. Allowance prices for Clean Power Plan based on NVE's estimate of carbon allowance prices from its recent Integrated Resource Plan. Prices based on CPP compliance starting in 2019.
	(8) Fuel Hedging	TBD; Given lack of current financial hedging, benefit quantification is challenging.
	(9) Environmental	Calculated the levelized value for Social Cost of Carbon based on the Environmental Protection Agency values. ¹

¹www3.epa.gov/climatechange/EPAactivities/economics/scc.html

²www.solarcity.com/sites/default/files/SolarCity_Distributed_Grid-021016.pdf

³www.nvenergy.com/company/rates/nv/electric/schedules/images/Statement_of_Rates_Electric_North.pdf

www.nvenergy.com/company/rates/sn/schedules/images/StatementofRates.pdf

Detailed Methodology

E3 methodology used when available, with specified modifications

	Categories	Methodology
Benefits	+ Renewable Certificates	Original E3 methodology included credits; however, solar costs have come down significantly since 2014. Therefore, no incremental value for renewable energy certificates was included.
	+ Voltage Support / CVR	Utilized voltage and consumption data related to demonstration projects to quantify the value of the reduction of energy consumption and CO2 emissions from the use of PV smart inverters within conservation voltage reduction schemes.
	+ Market Price Suppression	In the absence of hourly wholesale market price data, the potential avoided cost from market price suppression is challenging to quantify. For reference, in California, the value of market price suppression was quantified to be [\$0.05 / kWh]. ² Given lower energy prices, the value of market price suppression is expected to be lower in Nevada albeit above zero.
	+ Equipment Life Extension	Utilized IEEE C57.12.00-2000 standard per unit life calculation methodology to quantify the increased life for medium to large liquid-filled transformers from typical load and DER generation profiles. ²
	+ Reliability and Resiliency	N/a: Reliability and resiliency benefits assumed to be realized from the addition of energy storage.
Costs	(10) Utility Integration	Utilized base E3 assumptions and methodology
	(11) Utility Administration	Utilized base E3 assumptions and methodology
	Participant Bill Savings	Update to current NVE retail rates ³ . Utilize E3's lowest scenario for rate escalation: 0.5% escalation after 2019, instead of base assumption of 1.4%. 0.5% escalation is based on NVE's IRP projections through 2020.

¹www3.epa.gov/climatechange/EPAactivities/economics/scc.html

²www.solarcity.com/sites/default/files/SolarCity_Distributed_Grid-021016.pdf

³www.nvenergy.com/company/rates/nnv/electric/schedules/images/Statement_of_Rates_Electric_North.pdf;

www.nvenergy.com/company/rates/snv/schedules/images/StatementofRates.pdf

Next steps

- Gain input on methodology, inputs and analysis
- Finalize peer reviews
- Publish findings (estimated late May)



SolarCity

Thank you

PUC Nevada Orders

- PUC NV NEM Tariff Final Order: *"The NEM ratepayers' net excess energy is set at a value that captures the variables that make up the possible value/detriment of NEM during each general rate case. The Commission will set a value during each future general rate case by using a methodology that considers both the positive and negative effects of: 1) avoided energy; 2) energy losses/line losses; 3) avoided capacity; 4) ancillary services; 5) transmission and distribution capacity; 6) avoided criteria pollutant costs; 7) avoided carbon dioxide emission cost; 8) fuel hedging; 9) utility integration and interconnection costs; 10) utility administration costs; and 11) environmental costs."*
- PUC NV NEM Tariff Final Order: *"For other than the avoided energy and energy losses/line losses, there is insufficient time or data in this proceeding to assign a value to the other nine variables, but other information can be vetted in future general rate cases."*
- Sierra Pacific Power Company IRP Procedural Order: *"SPPC shall include...an analysis of the present worth of revenue requirement, ...societal cost, and economic impacts...for the following technologies: PV; PV... with... storage...". "...must consider and include variables that add value or costs to SPPC's electric system, including...: a) avoided/increased energy; b) net energy/line losses, utility integration and interconnection costs, and... voltage support; c) capacity/avoided capacity; d) ancillary services; e) changes to transmission and distribution capacity; f) avoided/increased criteria pollutant costs; g) avoided/increased carbon emission cost; h) fuel hedging; and i) diversity of resource and fuel supply."*

Description of Cost/Benefit Categories

	Category	Description
PUC Nevada NEM Order Categories	(1) Energy	The value of reduced wholesale energy purchases.
	(2) Energy Losses	The value of reduced energy losses.
	(3) Gen Capacity	The value of avoiding the need for system generation capacity resources to meet peak load and planning reserve requirements.
	(4) Ancillary Services	The value of a reduced need for operational reserves based on load reduction through DERs
	(5) T&D Capacity	The value of avoiding the need to expand transmission and/or distribution capacity to meet peak loads
	(6) Criteria Pollutants	The value of reduced criteria pollutant emissions
	(7) CO2 Emissions	The value of reduced CO2 emissions.
	(8) Fuel Hedging	The value of providing a physical hedge against uncertain future fuel prices and insurance against the impact of higher future fuel prices or changes in emissions policy.
	(9) Environmental costs	The value of reducing environmental impacts with externalities not included in the utility cost function.
New DER Categories	+ Voltage and Power Quality	The value of avoiding or reducing the cost required to maintain voltage and frequency within acceptable ranges for customer service.
	+ Cons. Voltage Reduction	The value of enabling conservation voltage reduction benefits by providing localized voltage support.
	+ Equipment Life Extension	The value of extending the useful life and improving the efficiency of distribution infrastructure by reducing load and thermal stress on equipment.
	+ Reliability and Resiliency	The value of avoiding or reducing the impact outages have on customers.
	+ Market Price Suppression	The value of reducing the electric demand in the market ,hence reducing market clearing prices for all consumers of electricity.

Methodological Overview

PUC Nevada Order – Benefit Categories

Category	Methodology
(1) Energy	Estimate of hourly marginal wholesale value of energy based on production simulation runs from NV Energy’s 2013 IRP based on gas prices as of April 2016. These simulations produced energy prices for each utility from 2014 through 2043
(2) Energy Losses	Estimate of energy generation losses between the point of wholesale transaction and the point of delivery based on losses as a function of hourly load from NVE North’s 2013 GRC and NVE South’s 2011 GRC.
(3) Gen Capacity	Estimate of marginal cost of meeting system peak loads, which is assumed to be the fixed O&M cost of NV Energy’s marginal capacity resource in the short term and the cost of new capacity in the balance year, based on NV Energy’s most recent GRCs.
(4) Ancillary Services	Estimate of marginal cost of providing spinning reserves for electricity grid reliability based on NV Energy summary for total energy production cost spending and spinning reserve spending for 2014-2018. NV Energy’s A/S costs as % of total energy spend was used to calculate A/S avoided costs as a share of energy generation avoided costs.
(5) T&D Capacity	Estimate of the cost of expanding transmission and distribution capacity to meet customer peak loads based on NV Energy’s most recent GRC and NV Energy Normalized Probability of Peak (POP) for 2014-2043.
(6) Criteria Pollutants	Estimate of criteria pollutant health impact costs from NV Energy’s 2013 IRP from avoiding or increasing fossil fuel combustion, including Nox, PM, SO2 and mercury.
(7) CO2 Emissions	Estimate of regulatory price of CO2 emissions beginning in 2018 based on production simulation runs from NV Energy’s 2013 IRP.
(8) Fuel Hedging	Estimate of the benefit of reducing volatility and uncertainty through physical hedges based on academic literature on the consumer cost of volatility.
(9) Environmental costs	Estimate of the benefit of reducing environmental externalities that are not explicitly priced into the utility cost function, including the long run cost of cost, based on the EPA’s Societal Cost of Carbon.

PUC
Nevada
NEM Order
Categories

Methodological Overview

Additional DER Categories

	Category	Methodology
	+ Voltage and Power Quality	Estimate of the utility equipment costs related to voltage and power quality that can be avoided by Smart Inverters based on equipment costs provided by Black and Veatch for the WECC area.
	+ Cons. Voltage Reduction	Estimate of the incremental energy savings that can be enabled by Smart Inverters providing conservation voltage reduction by reducing customer service voltages in order to achieve a corresponding reduction in energy consumption.
New DER Categories	+ Equipment Life Extension	Estimate of the benefits of reducing peak and average load on transmission and distribution equipment that reduces equipment degradation and correspondingly extends useful life based on IEEE thermal degradation models.
	+ Reliability and Resiliency	Estimate of the value of customer outages that are avoided by DERs based on the Department of Energy's value of lost load (VOLL) ICE calculator.
	+ Market Price Suppression	Estimate of the value of reducing the electric demand in the market ,hence reducing market prices for all consumers of electricity, based on hourly Long Term Procurement Plan (LTPP) production simulations for the year 2024, NVE IRP filings and NYMEX forward gas prices.