BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Application of SAN DIEGO GAS & ELECTRIC COMPANY (U 902 M) for Approval of its Energy Storage Procurement Framework and Program As Required by Decision 13-10-040.	Application No. 14-02-___ (Filed February 28, 2014)

Application No. 14-02-___
Exhibit No.: (SDG&E-3)

PREPARED DIRECT TESTIMONY OF

ARMANDO INFANZON

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA
FEBRUARY 28, 2014

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PREPARED DIRECT TESTIMONY OF
ARMANDO INFANZON
ON BEHALF OF SDG&E

I. INTRODUCTION / OVERVIEW

The purpose of my testimony is to describe the evaluation protocols to be used by SDG&E for each of the domains proposed for solicitation for the 2014 procurement cycle and described in the testimony of Mr. Charles for procuring energy storage pursuant to California Public Utilities Commission ("CPUC") decision ("D.") 13-10-040[1] ("the Energy Storage Decision").

II. BACKGROUND

The Energy Storage Decision established the "Energy Storage Procurement Framework and Design Program". As part of this framework, SDG&E was directed to include in this application "a proposed methodology for an analysis that evaluates bids on cost and fit submitted in a solicitation that draws on:

- The full range of benefits and costs identified in the use case framework developed and the EPRI and DNV KEMA reports submitted in this proceeding;
- An optional utility-specific proprietary evaluation protocol; and
- An evaluation protocol consistent across the IOUs that includes a consistent set of assumptions and methods for valuing storage benefits, such as market

[1] D.13-10-040 – Decision Adopting Energy Storage Procurement Framework and Design Program – was issued on 10/21/2013 and can be found on the CPUC website at: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M079/K533/79533378.PDF

services and avoided costs, and estimating project costs that allow adjustments for utility-specific factors (such as location, portfolio, cost of capital, etc.) and utility-specific modeling tools based outputs affecting valuation as appropriate to provide a consistent basis for comparison across utilities, bids and use cases. The consistent evaluation protocol shall be developed by the IOUs through joint consultation between the IOUs and the Commission Staff prior to the filing of the application and referenced in that application."[2]

III. FUNDAMENTALS OF ECONOMIC ANALYSIS FOR ENERGY STORAGE SYSTEMS

Energy storage systems, as new and nascent technology, present several fundamental aspects that complicate the economic analysis for procuring cost-effective energy storage capacity. Some of these aspects include, but are not limited to:

- Length of Contracts/Useful Life – offers under an RFO process will include different contract length durations. Utility-owned energy storage systems could have different useful lives based on the type of technology.
- Technology Risk – there are different technologies for energy storage systems. Each technology will have different risks inherent to that type of technology and the maturity level of each technology.
- Location of Project – Value of projects/offers will depend based on the location of the project.
- Portfolio and Resource Diversity
- DBE Factor and Benefits to Low Income or Minority Communities

[2] Ibid at Page 9 of Appendix A.

SDG&E will conduct an analysis to normalize all proposals in order to have a selection process as transparent as possible which does not favor any technology or counterparty and that it can evaluate all proposals on an apples-to-apples comparison. A framework to accomplish this normalization could be using a normalization index. SDG&E will work with its Independent Evaluator to develop an energy storage normalization index as part of the evaluation protocol to be used for the 2014 solicitation cycle.

IV. EVALUATION PROTOCOL FOR LOCAL AND FLEXIBLE CAPACITY REQUIREMENTS – TRANSMISSION CONNECTED FOR THE 2014 SOLICITATION CYCLE.

As further discussed in the testimony of Mr. Charles, SDG&E intends to procure third party owned energy storage capacity within the transmission domain via a Request for Offer ("RFO") process. As part of this RFO process, SDG&E will follow a similar methodology as that articulated in SDG&E's LTPP that includes among other steps the preparation of an evaluation protocol for offer analysis and selection. The evaluation protocol described hereafter is SDG&E's current perspective to analyze offers for third-party owned energy storage capacity to ensure that the offer selection process is transparent and does not favor any particular length of contract, technology or counterparty. This evaluation protocol may require adjustments before issuing of the RFO in order to account for potential market, regulatory, and/or business context changes. SDG&E will work with its Independent Evaluator ("IE") to revise this methodology as necessary.

SDG&E is proposing a method similar to the Least-Cost, Best-Fit ("LCBF") evaluation approach for the Local and Flexible Capacity Requirements – Transmission

Connected RFO. This approach will be used to apply a consistent evaluation criteria for ranking offers received during the RFO. The SDG&E approach will:

- Apply constraints such as meeting energy storage procurement targets and honoring physical constraints.
- Normalize non-standard attributes of differing energy storage technologies to allow for comparison between offers.

The primary quantitative metric to be used in the LCBF evaluation is the project Net Market Value ("NMV"). The NMV calculation sums all quantifiable benefits then subtracts all quantifiable cost to determine the offer's NMV as illustrated in the following equation:

NMV = (Quantifiable Benefits) – (Quantifiable Cost)

NMV's quantifiable benefits are based on those products in which there is a current CAISO product and include:

- Capacity Benefits – to the extend the capacity provided by the energy storage project can be counted towards a CAISO Load Serving Entities (LSEs) local or system RA requirements
- Flexible Capacity Benefits – to the extent compensated in the CAISO markets and not captured by capacity benefits, energy benefits or ancillary service benefits
- Energy Benefits
- Ancillary Services Benefits

NMV's quantifiable costs include, but are not limited to:

- Energy storage agreement (contract) costs – SDG&E will calculate a levelized contract cost.

- Interconnection costs – Network upgrade costs for interconnection of the energy storage system. If an interconnection cost estimate cannot be provided by the bidder due to timing of interconnection studies, SDG&E may assign a network upgrade cap value (based on a reasonable estimate of such costs) for purposes of evaluating the offer. If this cap value is then exceeded when the interconnection cost studies are completed, a walk away provision could be included in the energy storage contract.
- Congestion-related costs if applicable – SDG&E will conduct a marginal analysis to determine the difference in locational pricing between the project's point of delivery and SDG&E's default load aggregation point ("DLAP"). SDG&E will work with the IE to establish the proper methodology to include this cost as part of the NMV.

Any other benefits or costs that are identified and able to be suitably quantified (such as those included in the Electric Power Research Institute ("EPRI") and DNV KEMA Energy & Sustainability ("DNV KEMA") use-case frameworks) may be used in the NMV calculation.

SDG&E might also propose utility-owned energy storage systems to provide capacity for the Local and Flexible Capacity Requirement program as indicated in the testimony of Mr. Charles. SDG&E will calculate the same quantitative benefits and quantitative costs as previously described for the LCBF. For utility-owned energy storage systems the levelized cost will be calculated using traditional utility ratemaking methodologies to calculate revenue requirements for utility-owned infrastructure. SDG&E will then compare on an apples-to-apples basis the cost-effectiveness of utility-owned energy storage capacity versus third-party owned capacity in order to propose the best option.

In order to evaluate these costs and benefits, an SDG&E specific modeling approach will be used that will analyze the charging and discharging of the energy storage system to achieve an optimization of the contracted energy storage project. SDG&E will develop/procure modeling tools to conduct the quantitative analysis under the LCBF and NMV methodology. This analysis includes the calculation of quantitative benefits including capacity benefits, energy benefits and ancillary services ("AS") benefits including the modeling of future values for energy, capacity and AS and the corresponding operation of the storage system (that is, when will the system be 'charging' and when will it be 'discharging' and what are the costs and benefits associated with each) over the analysis time-frame. Quantifiable costs will also be modeled including contract costs, network upgrade costs and congestion costs (or benefits) over the same analysis timeframe. SDG&E will use these modeling tools to analyze and optimize each of the offers received. In addition, SDG&E will use these modeling tools to conduct the analysis required under the CEP. SDG&E is proposing in Section C of the testimony of Ms. Fang the cost recovery for these expenses to procure/develop the modeling tools.

Additional project-specific qualitative benefits may be used to further differentiate closely-ranked offers. SDG&E will conduct a process to normalize for different lengths of contracts, useful lives where applicable, technology, operational characteristics and risk profiles.

V. EVALUATION PROTOCOL FOR LOCAL AND FLEXIBLE CAPACITY REQUIREMENTS – DISTRIBUTION CONNECTED FOR THE 2014 SOLICITATION CYCLE.

As further discussed in the testimony of Mr. Charles, SDG&E intends to procure third party owned energy storage capacity within the distribution domain via a Request for Offer ("RFO") process for the Local and Flexible Capacity Requirements program. SDG&E will use the LCBF described in Section IV to analyze third-party owned offers for this program. The evaluation protocol described in Section IV is SDG&E's current proposal to analyze offers from third-party owned energy storage capacity to ensure that the bid selection process is transparent and does not favor any technology or counterparty. This evaluation protocol may require adjustments before issuing of the RFO in order to account for potential market, regulatory, and/or business context changes. SDG&E will work with its Independent Evaluator ("IE") to revise this methodology as necessary.

SDG&E might also propose utility-owned energy storage systems to provide capacity for the Local and Flexible Capacity Requirement program as indicated in the testimony of Mr. Charles. (SDG&E will calculate the same quantitative benefits and quantitative costs as described in Section IV for the LCBF.) For utility-owned energy storage systems the levelized cost will be calculated using traditional utility ratemaking methodologies to calculate revenue requirements for utility-owned infrastructure. SDG&E will then compare on an apples-to-apples basis the cost-effectiveness of utility-owned energy storage capacity versus third-party owned capacity in order to propose the best option.

In order to evaluate these costs and benefits, an SDG&E specific modeling approach will be used that will analyze the charging and discharging of the energy storage system to achieve an optimization of the contracted energy storage project. SDG&E will develop/procure modeling tools to conduct the quantitative analysis under the LCBF and NMV methodology. This analysis includes the calculation of quantitative benefits including capacity benefits, energy benefits and ancillary services ("AS") benefits including the modeling of future values for energy, capacity and AS and the corresponding operation of the storage system (that is, when will the system be 'charging' and when will it be 'discharging' and what are the costs and benefits associated with each) over the analysis time-frame. Quantifiable costs will also be modeled including contract costs, network upgrade costs and congestion costs (or benefits) over the same analysis timeframe. SDG&E will use these modeling tools to analyze and optimize each of the offers received. In addition, SDG&E will use these modeling tools to conduct the analysis required under the CEP. SDG&E is proposing in Section C of the testimony of Ms. Fang the cost recovery for these expenses to procure/develop the modeling tools.. Additional project-specific qualitative benefits may be used to further differentiate closely-ranked offers. SDG&E will conduct a process to normalize for different lengths of contracts, useful lives where applicable, technology, operational characteristics and risk profiles.

VI. EVALUATION PROTOCOL FOR DISTRIBUTION RELIABILITY/POWER QUALITY PROJECTS

The Energy Storage Decision directed SDG&E to continue procuring energy "storage systems involving distribution reliability applications shall be procured via existing processes used by IOUs for other distribution reliability utility assets."[3] As part of this process, SDG&E will select the best option based on quantitative costs and

[3] See D.13-10-040, p.5.

benefits as well as qualitative aspects. SDG&E will compare utility-owned energy storage systems versus other traditional or alternative solutions for the use cases and application that SDG&E will propose under the distribution reliability/power quality projects. As indicated in the testimony of Mr. Charles, SDG&E will conduct a competitive Request for Proposals process to procure these energy storage systems based on existing supply management methodologies. The following are some of the areas that SDG&E will cover as part of this evaluation protocol:

- Conduct an RFP process based on technical and operational requirements required for each of the use cases and applications proposed under this program.
- Conduct an analysis of all the conforming offers received from qualified vendors/developers.
- Compare the cost for energy storage systems to the cost of other traditional and alternative solutions.
- Calculate quantifiable benefits for the energy storage systems and other traditional and alternative solutions.
- Calculate and compare real and/or nominal Benefit-to-Cost ratios of energy storage systems to other traditional and alternative solutions.
- Identify and compare qualitative benefits for energy storage systems and other traditional and alternative solutions.

In order to evaluate these costs and benefits, an SDG&E specific modeling approach will be used that will analyze the charging and discharging of the energy storage system to achieve an optimization of the energy storage systems to be procured. SDG&E will develop/procure modeling tools to conduct the quantitative analysis to select the best option under the distribution reliability/power quality. This analysis includes the calculation of quantitative benefits and cost for the different use cases and application to be proposed by SDG&E for all utility-owned energy storage systems. SDG&E will use these modeling tools to analyze and optimize each of the proposed systems to compare with other traditional and alternative options for each of the use cases and applications to be proposed by SDG&E. SDG&E is proposing in Section C of the testimony of Ms. Fang the cost recovery for these expenses to procure/develop the modeling tools.

VII. EVALUATION PROTOCOL FOR CUSTOMER DOMAIN

SDG&E is not proposing any new programs for the 2014 solicitation cycle as indicated in the testimony of Mr. Charles. As a result, SDG&E is not proposing an evaluation protocol for procuring energy storage capacity for the customer domain at this time. SDG&E will propose an evaluation protocol once a specific new program is proposed in future cycles or via another application.

VIII. CONSISTENT EVALUATION PROTOCOL

The Energy Storage Decision directed SDG&E and the other IOUs to use a consistent evaluation protocol ("CEP") to analyze the offers received for each of the RFOs to be proposed by the each utility. The Energy Storage Decision stated the following:

- "An evaluation protocol consistent across the IOUs that includes a consistent set of assumptions and methods for valuing storage benefits, such as market services and avoided costs, and estimating project costs that allow adjustments for utility-specific factors (such as location, portfolio, cost of capital, etc.) and utility-specific modeling tools based outputs affecting valuation as appropriate to provide a consistent basis for comparison across utilities, bids and use cases. The consistent evaluation protocol shall be developed by the IOUs through joint consultation between the IOUs and the Commission Staff prior to the filing of the application and referenced in that application."[4]

The adopted CEP is included in Attachment A. SDG&E will use the CEP for the RFO process of the Local Capacity and Flexible Requirements – Transmission Connected and Distribution Connected programs in addition to the evaluations protocols described in Section II and III of this testimony.

The CEP will be used as a tool by the CPUC to benchmark and compare bids and general reporting purposes but will not necessarily be used as the basis for bid selection by SDG&E.

In order to evaluate these costs and benefits under the CEP, an SDG&E specific modeling approach will be used that will analyze the charging and discharging of the energy storage system to achieve an optimization of the contracted energy storage project.

IX. CONCLUSION

This concludes my prepared direct testimony.

[4] D. 13-10-040 at Page 9 of Appendix A.

X. STATEMENT OF QUALIFICATIONS

My name is Armando Infanzon. My business address is 9305 Lightwave Avenue, San Diego, California 92123. I am employed by SDG&E as Smart Grid Policy Manager for SDG&E's Smart Grid Initiatives. My present responsibilities are the development of strategy and policy of Smart Grid initiatives, including energy storage systems, and to represent SDG&E on regulatory and legislative issues at state and federal level.

I have been employed by Sempra Energy and/or SDG&E since 1998 and have held various management level positions covering an array of different areas including economic analysis, financial planning, corporate finance, business development, and regulatory and energy policy.

I received a bachelor degree in accountancy from the Autonomous University of Baja California in 1997 and a master degree in business administration from San Diego State University in 2000.

I have not testified previously before this Commission.

Attachment A

CONSISTENT EVALUATION PROTOCOL

CONSISTENT EVALUATION PROTOCOL (CEP) FOR ENERGY STORAGE BENCHMARKING AND GENERAL REPORTING PURPOSES

February 28, 2014

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CONSISTENT EVALUATION PROTOCOL (CEP) FOR ENERGY STORAGE BENCHMARKING AND GENERAL REPORTING PURPOSES

A. Background and Scope

1. Background

The Decision Adopting Energy Storage Procurement Framework and Design Program ("the Decision") requires the Investor Owned Utilities ("IOUs") to confer with Energy Division Staff to develop a consistent evaluation protocol to be used for benchmarking and general reporting purposes.[1] Accordingly, Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison worked with the Energy Division to create this "Consistent Evaluation Protocol" ("CEP") document.

In Appendix A of the Decision, Section (3)(d), the CEP is described further as the following.

> *"An evaluation protocol consistent across the IOUs that includes a consistent set of assumptions and methods for valuing storage benefits, such as market services and avoided costs, and estimating project costs that allow adjustments for utility-specific factors (such as location, portfolio, cost of capital, etc.) and utility-specific modeling tools based outputs affecting valuation as appropriate to provide a consistent basis for comparison across utilities, bids, and use cases."*

The CEP includes both quantitative and qualitative information. The CEP is not meant to directly correlate to IOU specific evaluation or shortlisting criteria. Therefore, the outcome under the CEP will differ from the outcome under the IOU specific evaluation protocol.

2. Scope

Nothing in the CEP is to be construed or implied as restricting or invalidating the assumptions, models, tools, and analysis each IOU might choose to value, rank, or shortlist the physical and financial merits of offers or bids from the IOUs' energy storage solicitations (Offers) that might be received to comply and fulfill each IOU's energy storage needs at the transmission, distribution, and customer levels.

[1] D.13-10-040, at 63.

As stated in the Decision, the CEP is only for “benchmarking and general reporting purposes” and is not a replacement for the IOUs’ individual, proprietary, evaluation protocols to be used to evaluate the cost and benefits or other quantitative or qualitative aspects of Offers resulting from IOU energy storage solicitations.

The CEP is focused on the methodology to determine Net Market Value (NMV).[2] For the CEP to yield consistent numerical results across the IOUs for reporting purposes, publicly available information will be used as a substitute for the confidential, commercially-sensitive inputs the IOUs will use in evaluation of actual commercial Offers from market participants.

Beyond NMV, each IOU will have specific qualitative and quantitative elements that will be used to evaluate and select energy storage projects. Those IOU-specific qualitative and quantitative elements are not included in the CEP and will not be limited by the CEP. The Decision clarifies this intent as follows.

> *“We agree with parties that any actual finding of cost-effectiveness should only be done in a utility application for approval of storage contracts or rate-based additions, where there is a specific project and actual project inputs... As such, we* ***shall allow the IOUs to propose their own methodology to evaluate the cost and benefits of bids****.[emphasis added]”*

The CEP shall not be implemented into a model. To complete the CPUC’s benchmarking and reporting goals, each IOU will evaluate the quantitative and qualitative elements of short-listed energy storage projects through its respective models, albeit using publicly available input assumptions needed to calculate NMV.[3] Given that the purpose of the CEP is to provide a succinct comparison tool for storage Offers, it is not possible to capture every cost and benefit of storage Offers in the CEP. The scope of the CEP includes all three of the storage domains defined in the Decision—transmission, distribution and customer—in either a quantitative or qualitative form.

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[3] Described in Section C below.

B. Presentation Format for CEP and Confidentiality

1. Presentation Format for CEP

The presentation format for Offers under the CEP will be an electronic spreadsheet, an example of which is included as Attachment 1 of this document (the Spreadsheet).[4] The Spreadsheet will include prescribed column headings for information describing the Offers. Per the Decision, this information will be based on a, "consistent set of assumptions and methods for valuing storage benefits" as described herein. For each of the Offers, the Spreadsheet will include:

- **<u>Descriptive information</u>** about the Offers and their proposed projects, as described in Section D below.
- **<u>Quantitative information</u>** consisting of an NMV calculation, inputs to NMV, and the benefit and cost components used to calculate NMV, as described in section Section E below.
- **<u>Qualitative information</u>** consisting of a "yes/no" indication of which energy storage 'end uses'[5] might exist for each of the Offers, as described in section Section F below.

The Spreadsheet will not include all evaluation rating or ranking elements or criteria that may be considered in utilities' evaluations of Offers. For example, the Spreadsheet does not capture information on (1) Location, (2) Portfolio Need, (3) Contract Length, (4) Project Viability, (5) Supplier Diversity, (6) Credit Status including Counterparty Concentration, (7) Number of Proposed Modifications to the Power Purchase Agreement ("PPA") and (8) the Offer's consistency with and contribution to California's goals for the energy storage program.

2. Confidentiality

Information provided to the California Public Utilities Commission ("the Commission") via its staff is confidential under California Public Utilities Code Section 583 and confidentiality requirements contained in D.06-06-066 and D.13-10-040. However, such information may be shared with the

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[4] This document and its attached spreadsheet constitute the CEP in its entirety.

[5] As identified in the Decision Adopting Proposed Framework for Analyzing Energy Storage Needs (D.12-08-016), August 6, 2012, at 23.

California Independent System Operator ("CAISO"), each IOU's Procurement Review Group ("PRG"), or any other regulatory agencies under the appropriate confidentiality protection, without destroying the confidentiality protection afforded by the Commission.

C. Standardized Planning Assumptions

The calculation of NMV requires assumptions for several inputs, including, but not limited to,

- Forecast hourly energy prices,
- Forecast capacity prices,
- Forecast ancillary services value,[6]
- Forecast monthly natural gas prices,
- Discount rate,
- System loss factors, and
- Forecast greenhouse gas (GHG) costs.

For any calculations under CEP, publicly available information will be used. One of the Commission's consultants, Energy and Environmental Economics (E3)[7] produced an avoided cost calculator, which provides some public information. This avoided cost calculator includes a publicly available forecast of natural gas prices using the 2011 Market Price Referent (MPR) methodology and a public forecast of GHG prices using the 2009 MPR methodology.[8] In addition, E3's avoided cost calculator also includes public price forecasts for energy and capacity, system loss factors for each IOU, and discount rates for each IOU.[9] The most recent avoided cost calculator is named "DERAvoidedCostModel_v3.9_2011 v4d.xlsm" and is available on E3's

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[6] In the absence of a publicly available forecast of ancillary services prices, the CEP will use surrogate prices for ancillary services based on agreed upon monthly percentages of energy prices.

[7] For background, note that E3 also produced the Commission's Market Price Referent (MPR) model.

[8] The MPR models are available at http://www.ethree.com/public_projects/cpuc3.php

[9] E3's describes the source of inputs—e.g., discount rate, system losses and GHG costs—and calculation methodology of outputs—e.g., energy, capacity and natural gas prices—for the publicly available information in its avoided cost calculator in two documents at http://www.ethree.com/public_projects/cpucdr.php The names of the two documents are: "Revised DG Cost Effectiveness Framework Avoided Cost Methodology Description" and "Avoided Cost Methodology Description".

website.[10] The aforementioned information from E3's avoided cost calculator will be included in the CEP as input assumptions.

[10] http://www.ethree.com/public_projects/cpuc5.php

D. Descriptive Information Included in the CEP Spreadsheet

The CEP Spreadsheet will include descriptive information about the Offers as listed in Table 1.

Table 1
Descriptive Information Included in the CEP Spreadsheet

IOU (PGE / SCE / SDGE)	**Commercial Operation Date**	**Self-discharge** in Stand-by (MW/hour)
Name of Shortlisted Project	**Term** (Years)	**Ramp rate** – charge/discharge, up/down (MW/hour)
Interconnection Voltage (kV)	**Max Capacity –** Charge/Discharge at grid connection point (MW)	**AGC** (yes/no)
Interconnection Level (Transmission / Distribution)	**Min Capacity –** Charge/Discharge at grid connection point (MW)	**Regulation at zero** -- up/down (yes/no)
Local Capacity Area	**Qualifying RA Capacity** (MW)	**Contract Cost** ($)
Zone (NP / ZP / SP)	**Duration** of max sustainable discharge rate (Hours)	**Variable O&M** for discharging ($/MWh)
Status (New / Existing)	**Efficiency** at max capacity (%)	**Fixed O&M** ($/kW-year)
Product (Dispatchable / RA)	**Max daily switches** – charge/discharge (# charges per day)	
Energy Storage Technology	**Max cycles** per lifetime (# cycles)	

E. Quantitative Information Included in the CEP Spreadsheet

1. Net Market Value Overview

For the CEP, the Offers will be evaluated in terms of dollars per kilowatt ($/kW). NMV is the net present value (NPV) of future benefits minus future costs for the projects resulting from the Offers. The benefits will include the items listed in Table 2, levelized in $/kW. Costs will be defined as the direct and indirect, fixed and variable costs of a given project over its term. Costs will include the items listed in Table 2, levelized in $/kW. The CEP Spreadsheet will include quantitative information about the Offers as listed in Table 2 below.

Table 2
Quantitative Information Included in the CEP Spreadsheet

Market Benefits (Levelized $/kW)	**Market Costs** (Levelized $/kW)
Capacity / Resource Adequacy Value	Fixed Capacity Payments and Fixed O&M Cost
Energy Value	Charging Costs and Variable O&M Cost
Ancillary Services Value	Network Upgrade Cost (paid by CAISO consumers)
Distribution Investment Deferral Value (if applicable to project)	GHG Compliance Cost (if applicable to project)
	Debt Equivalency Cost
	Market Participation Costs

NMV is calculated for each Offer with the following formula based on publicly available information:

NMV = (C + E + AR + DD) – (F + V + N + GHG + DE + MPC)

Where:

C = Capacity / Resource Adequacy Value

E = Energy Value

AR = Ancillary Services Market Value

DD = Distribution Investment Deferral Value

F = Fixed Capacity Payments and Fixed O&M Cost

V = Charging Costs and Variable O&M Cost

N = Network Upgrade Cost

GHG = GHG Compliance Cost (if applicable to project)

DE = Debt Equivalency Cost

MPC = Market Participation Costs

2. **Capacity / Resource Adequacy Value**

The value of capacity / resource adequacy (RA) associated with each Offer will be determined based on the projected monthly qualifying RA capacity and publicly available forecast capacity prices.

3. **Energy Value**

The market value of energy deliveries is based on the hourly generation profile of each Offer considering operating characteristics and limitations, such as delivery date, delivery term and delivery location and operational constraints. The market value of the energy will be based on the publicly available forecast energy prices. The quantity of energy delivered will be an output of each IOU's dispatch modeling tool. System loss factors both at the transmission and distribution level depending on the interconnection will be used to incorporate losses specific for each IOU.

4. **Ancillary Services Value**

Ancillary Services (AS) value will be assessed based on the ancillary service capability of each Offer. In the absence of a publicly available forecast of AS prices, the CEP will use surrogate prices for ancillary services based on agreed upon monthly percentages of hourly energy prices.[11] AS values will be determined by each IOU's dispatch modeling tool using the surrogate AS prices. An energy storage device can generally operate in either the AS market or the real time energy market but not both.

5. **Distribution Investment Deferral Value**

For Offers that provide a distribution investment deferral value, as calculated by each IOU using its own criteria, the resultant value will be shown for benchmarking and reporting purposes.

6. **Fixed Capacity Payments and Fixed O&M Cost**

The fixed payments for the project will be provided in the Offers.

7. **Charging Costs and Variable O&M Cost**

Charging costs for energy storage includes the cost of electricity to charge the project. The source of Variable Operations and Maintenance (O&M), station

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[11] Before utilities submit their completed CEP Spreadsheets including information on their shortlisted Offers, the IOUs will work with the Energy Division to determine the appropriate AS price forecast to be used in the CEP valuation.

use and other variable costs will be provided in the Offers. The amount of charging used by an energy storage project will be determined by each IOU's dispatch modeling tool.

8. Network Upgrade Cost

Transmission or distribution network-related costs will be part of the Offer's NMV. The IOUs may obtain and use results from Participants' interconnection studies, if available. Otherwise each IOU will develop and use its own estimate for transmission and distribution network upgrade costs.

Each Offer will include in its bid price the estimated cost of all the facilities needed to interconnect the project to the first point of interconnection with the transmission system grid. These facilities are referred to as direct assignment facilities, or "gen-ties". Because these costs are in the bid price, they are not included in the calculation of the transmission adder.

Network upgrades include all facilities that: (i) enable the project to be fully deliverable for RA counting purposes (upgrades after the point where a project's electricity first interconnects with and enters the subject utility's transmission grid); and (ii) transmit or deliver the full amount of power from the Project. Network upgrades include (a) transmission lines, (b) transformer banks, (c) special protection systems, (d) substation breakers, (e) capacitors, and (f) other equipment needed to transfer power to the consumer.

9. GHG Compliance Cost

For any energy storage project that includes technology that generates GHG emissions, a GHG compliance cost will be calculated and included in the NMV.

10. Debt Equivalence Cost

Long-term procurement contracts held by IOUs are treated by credit rating agencies as equivalent to long-term debt. This "debt equivalence" increases an IOUs borrowing costs.

11. Market Participation Costs

For example, in order to arbitrage the day-ahead and RT market, the storage device must overcome the difference between the day-ahead and RT Grid Management Charge ("GMC") cost.

F. Qualitative Information Included in the CEP Spreadsheet

To incorporate some qualitative value that cannot be captured in the quantitative metrics, the CEP Spreadsheet also includes a grid of twenty 'end uses' as identified in the Decision Adopting Proposed Framework for Analyzing Energy Storage Needs[12] and listed in Table 3, below. For each offer, the utility will identify which end uses are present. However, there will be no specific quantitative assessment of the benefits of end uses in the CEP Spreadsheet, other than those qualities already captured in the quantitative metrics discussed in Section E.

Table 3
End Uses Included in the CEP Spreadsheet

1. Ancillary Services: frequency regulation	8. Intermittent resource integration: wind (ramp/voltage support)	15. Distribution peak capacity support (upgrade deferral)
2. Ancillary services: spin / non-spin / replacement reserves	9. Intermittent resource integration: photovoltaic (time shift, voltage sag, rapid demand support)	16. Distribution operation (voltage / VAR support)
3. Ancillary services: ramp	10. Supply firming	17. Outage mitigation: micro-grid
4. Black start	11. Peak shaving	18. Time-of-use (TOU) energy cost management
5. Real time energy balancing	12. Transmission peak capacity support (upgrade deferral)	19. Power quality
6. Energy price arbitrage	13. Transmission operation (short duration performance, inertia, system reliability)	20. Back-up power
7. Resource Adequacy	14. Transmission congestion relief	

Note: the benefit of all end uses is not simply a sum of the benefits for each end use. In many cases, allocating some portion of an energy storage project to one end use limits the ability of that portion of the energy storage project to satisfy any other end use.

12 Decision Adopting Proposed Framework for Analyzing Energy Storage Needs (D.12-08-016), August 6, 2012, at 23.

Attachment 1 to the Consistent Evaluation Protocol: "CEP Spreadsheet"

CONFIDENTIAL INFORMATION. Data provided to the CPUC herein is confidential under California Public Utilities Code Section 583, D.06-06-066, and D.13-10-040.

The Consistent Evaluation Protocol (CEP) is for energy storage benchmarking and general reporting purposes, per D.13-10-040.

		1	2	3	4	5	6	7	8	9	10	11
Descriptive Items												
	IOU (PGE / SCE / SDGE)											
	Name of Shortlisted Project											
	Interconnection Voltage (kV)											
	Interconnection Level (Transmission / Distribution)											
	Local Capacity Area											
	Zone (NP / ZP / SP)											
	Status (New / Existing)											
	Product (Dispatchable / RA)											
	Energy Storage Technology											
	Commercial Operation Date											
	Term (Years)											
	Max Capacity (MW)											
	Min Capacity (MW)											
	Qualifying RA Capacity (MW)											
	Duration of Max Sustainable Discharge Rate (Hours)											
	Efficiency at Max Capacity (%)											
	Max Daily Switches -- Charge / Discharge (# Charges)											
	Max Cycles per Lifetime (# Cycles)											
	Self-Discharge in Stand-by (MW / Hour)											
	Ramp Rate -- Charge / Discharge, Up / Down (MW / Hour)											
	AGC (Yes / No)											
	Regulation at Zero (Yes/No)											
	Contract Cost ($)											
	Variable O&M for Discharging ($/MWh)											
	Fixed O&M ($/kW-Year)											
Quantitative Items*												
Market Benefits (CEP Assumptions)	Levelized Capacity RA Value ($/kW)											
	Levelized Energy Value ($/kW)											
	Levelized Ancillary Services Value ($/kW)											
	Distribution Investment Deferral Value - if applicable ($/kW)											
Market Costs (CEP Assumptions)	Levelized Capacity Payments and Fixed O&M Cost ($/kW)											
	Levelized Charging Costs and VOM Cost ($/kW)											
	Levelized Network Upgrade Cost ($/kW)											
	Levelized GHG Compliance Cost (if applicable) ($/kW)											
	Levelized Debt Equivalency Cost ($/kW)											
	Levelized Market Participation Costs ($/kW)											
NPV (CEP Assumptions)	Levelized Net Market Value $/kW											
NPV (Proprietary IOU Assumptions)	Levelized Net Market Value $/kW											
Applicable End Uses												
ISO / Market	Ancillary Services: Frequency Regulation											
	Ancillary Services: Spin / Non-Spin / Replacement Reservces											
	Ancillary Services: Ramp											
	Black Start											
	Real Time Energy Balancing											
	Energy Price Arbitrage											
	Resource Adequacy											
Generation	Intermittent Resource Integration: Wind (Ramp / Voltage Support)											
	Intermittent Resource Integration: PV (Time Shift, Voltage Sag, Rapid Demand Support)											
	Supply Firming											
Transmission / Distribution	Peak Shaving											
	Transmission Peak Capacity Support (Upgrade Deferral)											
	Transmission Operation (Short Duration Performance, Inertia, System Reliability)											
	Transmission Congestion Relief											
	Distribution Peak Capacity Support (Upgrade Deferral)											
	Distribution Operation (Voltage / VAR Support)											
Customer	Outage Mitigation: Micro-Grid											
	Time-of-Use (TOU) Energy Cost Management											
	Power Quality											
	Back-Up Power											

*With the exception of "NPV (Proprietary IOU Assumptions)" all of the Quantiative Items are calculated using standardized planning assumptions, as discussed in the Section C of the CEP.