BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Application of San Diego Gas & Electric Company (U 902-E) for Approval of Electric Program Investment Charge Triennial Plan for Years 2018-2020	A.17-05-_____ (Filed May 1, 2017)

APPLICATION OF SAN DIEGO GAS & ELECTRIC COMPANY (U 902-E) FOR APPROVAL OF ELECTRIC PROGRAM INVESTMENT CHARGE TRIENNIAL PLAN FOR YEARS 2018-2020

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I. INTRODUCTION

In compliance with California Public Utilities Commission ("Commission") Decisions ("D.") 12-05-037 and 11-12-035, and pursuant to Rule 2.1 of the Commission's Rules of Practice and Procedure, San Diego Gas & Electric Company ("SDG&E") hereby submits this application ("Application") for Approval of its Third Triennial Electric Program Investment Charge ("EPIC") Investment Plan ("EPIC-3 Plan") to the Commission.

II. BACKGROUND

EPIC was established by the Commission in D.11-12-035 to "provide public interest investments in applied research and development, technology demonstration and deployment, market support, and market facilitation of clean energy technologies and approaches for the benefit of electricity ratepayers" of SDG&E, Pacific Gas and Electric Company ("PG&E") and Southern California Edison Company ("SCE") (collectively, the "IOU Administrators").[1] On May 31, 2012, the Commission issued D.12-05-037, which established the purposes and governance structure for EPIC.

[1] D.12-05-037 at 2.

On November 1, 2012, SDG&E filed A.12-11-002, seeking approval for its First EPIC ("EPIC-1") Plan, in which it proposed to execute five smart-grid related projects. SDG&E's EPIC-1 Application was approved by D.13-11-025.

On May 1, 2014, SDG&E filed A.14-05-004, seeking approval for its Second EPIC ("EPIC-2") Plan, in which it proposed to execute five individual TD&D projects, as well as a sixth project through which SDG&E will participate in industry RD&D consortia. SDG&E's EPIC-2 Application was approved by D.15-04-020.

A. General Requirements

EPIC is designed to "be the primary vehicle for utility electric [research development & deployment ("RD&D")] proposals other than the proposals submitted by the utilities for demand response and electric efficiency RD&D projects."[2] The IOU Administrators may only administer projects funded by EPIC in the area of technology development and deployment ("TD&D").[3]

D.12-05-037 requires that the "coordinated"[4] EPIC plans be submitted on May 1, 2017 by the four EPIC Administrators – the three IOUs and the California Energy Commission ("CEC") – meet the following common requirements:

- Any projects funded through EPIC must, first and foremost, demonstrate "the potential to produce electricity ratepayer benefits, defined as promoting greater reliability, lower costs, and increased safety"[5];

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2 *Id*. at Conclusions of Law ("COL") 15.

3 *Id*. at Findings of Fact ("FOF") 8.

4 *Id*. at FOF 9.

5 *Id*. at FOF 1.

- EPIC expenditures are to be guided by the complementary principles of providing societal benefits, assisting with the reduction of greenhouse gas ("GHG") emissions in the electricity sector at the lowest possible cost, supporting the Loading Order,[6] and contributing to goals related to low-emission vehicles and transportation, economic development, and efficient use of ratepayer monies;
- EPIC expenditures must follow the statutory guidance provided by sections 740.1 and 8360 of the California Public Utility Code;[7]
- EPIC Plans must be mapped to the electric utility value chain identified in D.12-05-037; and
- EPIC funds may not be used to fund duplicative activities.[8]

In addition, D.12-05-037 articulates specific information that the EPIC plans must include, such as summaries of and responses to stakeholder comments, informational summaries

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[6] Since 2003, Commission-regulated utilities have had to procure resources to serve demand per the "Loading Order," which is:

(1) Energy Efficiency & Conservation

(2) Demand Response

(3) Renewable Resources & Clean Distributed Generation, and

(4) Clean Conventional (Fossil) Generation, if necessary.

CPUC, Energy Action Plan, adopted April 18, 2003, available at http://docs.cpuc.ca.gov/published/report/28715.htm.

[7] D.12-05-037 at 18, COL 1 & Ordering Paragraph ("OP") 12(e). All statutory citations herein are to the California Public Utility Code, unless otherwise stated.

[8] *Id*. at 40, FOF 9. Thus, the Commission directs the EPIC Administrators to collaborate to "to ensure there is no duplication of effort".

of RD&D efforts underway through approved Energy Efficiency and Demand Response portfolios, and intended intellectual property ("IP") methodologies.[9]

III. SUMMARY OF THE APPLICATION

The SDG&E EPIC-3 Plan, provided as Attachment A, is fully consistent and responsive to the requirements of D.12-05-037, D.13-11-025 and D.15-04-020.[10] The Commission's directives, as well as SDG&E's demonstrated vision for EPIC-funded TD&D programs, warrant the Commission's approval of the SDG&E EPIC Plan. The projects proposed in the EPIC-3 Plan have the potential to provide Commission-mandated benefits of lower costs, greater reliability and increased safety, while offering benefits to electric utility ratepayers and alignment with State energy policies and statutes.

IV. SUMMARY OF THE SDG&E EPIC-3 PLAN

SDG&E's EPIC-3 Plan proposes seven individual TD&D projects. The SDG&E EPIC-3 portfolio has the potential to help improve safety, modernize the electric grid and improve customer benefits. Specifically, the seven projects are:

1. Integration of Battery and Photovoltaic Systems into Utility Operations: will demonstrate control and communication options for integrating battery, photovoltaic and other distributed energy resource ("DER") system combinations into utility distribution system operations. The project will identify best practices and make recommendations as to which practices should be adopted into commercial use.

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[9] D.12-05-037 at OPs 12(d) & 15; D.13-11-025 at 66-67.

[10] While SDG&E is not offering any testimony in support of its EPIC Plan in this Application, it will make qualified witnesses available at the Commission's request.

2. Energy Storage Performance Evaluation: will perform operational testing and staged tests of Vanadium Redox Flow ("VRF") batteries and Lithium Ion batteries to evaluate performance characteristics and understand ramifications for integration with power system infrastructure and operations. The test plan will be designed to provide a comparative basis for the two types of batteries.

3. Application of Advanced Metering Infrastructure ("AMI") Data to Advanced Utility System Operations: will demonstrate two critical capabilities (i.e., the AMI system as a voltage sensor network and a phase identification tool) for leveraging SDG&E's AMI system with its 1.4 million endpoints to provide actionable secondary voltage data and analysis to SDG&E and other prospective users.

4. Safety Training Simulators with Augmented Visualization: will demonstrate the capabilities of the latest simulator technologies for the utility industry with regards to safety-related items, such as electric potential zones and other grounding techniques associated around construction work practices. This will help develop and evaluate augmented reality applications to be used by crews in the field, in utility vehicles, and in the backend operations center for field focused design, operations, and asset monitoring and management solutions.

5. Unmanned Aircraft Systems ("UAS") with Advanced Image Processing for Electric Utility Inspection and Operations: will demonstrate new applications of UAS with enhanced image processing capabilities for electric operations. The project will define, demonstrate, and evaluate concept(s) for instrumentation and monitoring of the power system equipment using enhanced imaging on UAS and

sensor technology. The project will evaluate the resulting increase in reliability, safety, and cost efficiency to improve power system operations.

6. Repurposing Post Electric Vehicle Batteries for Utility, Commercial, and Mass Transit Applications: will perform pre-commercial demonstration of repurposed, used Electric Vehicle ("EV") batteries for the benefit the utility system operations, commercial customers, and/or mass transit (such as the electric trolley, light rail or electric transit buses). This Post Electric Vehicle Energy Storage ("PEVES") project will identify solutions to minimize installation and integration costs by reusing electric vehicle hardware and software.

7. Demonstration of Multipurpose Mobile Battery for Port of San Diego and/or Other Applications: will undertake a pre-commercial demonstration of a mobile battery system at the Port of San Diego's ("Port") cruise ship terminal during the peak cruise ship season and in other applications at other locations during non-peak season to evaluate stacking of various benefits that can be derived from the mobile battery, deployed at its primary location and different energy hubs at multiple locations.

The seven projects are described in detail in the attached SDG&E EPIC-3 Plan.

SDG&E is not aware of any other research and development programs that are duplicative of any of the seven projects.

A. Summary of Estimated Program Budget for EPIC-3 Reflects Escalation Estimate

SDG&E's total estimated budget for EPIC-3 is approximately $9,158.[11] The total project-level funding estimate for SDG&E EPIC Plan is $8,196k.[12] SDG&E estimates $916k for program-level administrative activities.[13] SDG&E estimates $46k for CPUC oversight costs.[14] In accordance with D.15-04-020, SDG&E's estimated total EPIC budget is provided in Table 1:[15]

[11] The $9,158k is calculated by taking the amounts shown in Tables 4 and5, Appendix B, of D.15-04-020 and then escalated by 2.065% to account for estimated inflation adjustment. The estimated inflation adjustment is based on the Urban Wage Earners and Clerical Workers CPI annual growth rate for the past three years (2014 – 2016), compounded by 3 years. SDG&E recognizes that the EPIC collections, and thus the EPIC allocations, will be adjusted on January 1, 2018. D.12-05-037 at OP 7. If the adjustment differs from the estimate of 2.065%, SDG&E intends to proportionally distribute the difference between the estimated and the actual adjustment among the total estimated funding shown in Table 1.

[12] All projects fall in the TD&D category. Because all seven projects are T&D projects, the estimated project funds can be reallocated among approved projects in the same category without limitation. *See* D.15-09-005 at COL 1.

[13] The $916k is 10% of the total budget of $9,158k. D.15-04-020 at OP10 ("Each Electric Program Investment Charge (EPIC) administrator's administrative budget shall be no more than 10% of their individual total EPIC budgets . . . ").

[14] D.15-04-020at OP9 (stating that the CPUC "oversight budget shall be funded as follows: CEC 80%, PG&E 10.02%, SCE 8.22%, and SDG&E 1.76%.").

[15] D.15-04-020 at OP10 (". . . each administrator's individual total EPIC budgets includes their program budget, administrative budget, and oversight budget.") & OP11 ("Each Electric Program Investment Charge (EPIC) Administrator shall, as part of all future EPIC applications, include a budget proposal in table format, broken down by each budget area, including grand totals, and presented for annual and triennial periods.").

Table 1[16]

Escalated Triennial Program Budget
by Funding Element (2018-2020)

Funding Element	Thousands 2017 Dollars
Applied RD&D	$ -
TD&D	8,196
Market Facilitation	-
Program Administration	916
CPUC Program Oversight	46
Total Program Funding	**$ 9,158**

The total project-level funding allocation for SDG&E EPIC Plan is $8,196k. Detailed project-level funding is provided in Table 2:

Table 2
Estimated Budget for SDG&E EPIC-3 TD&D Project Funding (2018-2020)

Investment Area for IOU Framework	Project Name	3-Year Project Estimate (Thousands 2017 dollars)
Grid Modernization and Optimization	Application of Advanced Metering Infrastructure (AMI) Data to Advanced Utility System Operations	1,771
	Safety Training Simulators with Augmented Visualization	833
	Unmanned Aircraft Systems (UAS) with Advanced Image Processing for Electic Utility Inspection and Operations	729
	Repurposing Post-Electric-Vehicle Batteries for Utility, Commercial, and Mass Transit Applications	833
Customer Services and Enablement	Demonstration of Multiple-Purpose Mobile Battery for Port of San Diego and Other Applications	937
Renewables and DER Integration	Integation of Battery and Photovoltaic Systems into Utility Operations	2,051
	Energy Storage Performance Evaluation	1,042
	Total Project Budget for EPIC-3 Cycle	$8,196

[16] D.15-04-020 at OP15 states "Administrators' 2018-2020 investment plans shall identify the amount of accumulated interest expected to reduce collections in that period, and their proposed budgets should be adjusted accordingly." SDG&E's proposed budget was not impacted by the reduced collections due to the return of interest. Note that figures in this table may differ slightly from those in Table 3 due to rounding.

V. NO RATE INCREASE IS REQUESTED BECAUSE EPIC FUND COLLECTIONS HAVE ALREADY BEEN AUTHORIZED

SDG&E is not requesting approval for a rate increase in this Application because the collection of EPIC funds from electric utility ratepayers was previously authorized in D.11-12-035,[17] D.12-05-037[18] and D.15-04-020.[19] SDG&E has been collecting funds in accordance with those decisions since January 1, 2012 through the electric Public Purpose Program ("PPP") bill component.[20]

A. SDG&E's Estimated EPIC Collection by Year

Table 3 shows SDG&E's estimated collections of EPIC funds, by year, for 2018-2020.[21]

Table 3[22]
Estimated SDG&E Annual Collection (2018-2020)

	2018		2019		2020		Total		
Escalated Annual Budget (2018-2020) (Thousands 2017 Dollars)	**SDG&E**	**SDG&E Collections for CEC**	**SDG&E**	**SDG&E Collections for CEC**	**SDG&E**	**SDG&E Collections for CEC**	**SDG&E**	**SDG&E Collections for CEC**	**Total Collections**
EPIC Funding Collection	$ 3,052	$ 12,210	$ 3,052	$ 12,210	$ 3,052	$ 12,210	**$ 9,157**	**$ 36,630**	**$ 45,787**
Credit for Estimated Accumulated Interest (through 12/31/17)	(69)	(274)	-	-	-	-	**(69)**	**(274)**	**(343)**
Adjusted EPIC Funding Collection	**$ 2,984**	**$ 11,936**	**$ 3,052**	**$ 12,210**	**$ 3,052**	**$ 12,210**	**$ 9,089**	**$ 36,356**	**$ 45,445**

[17] D.11-12-035 at OP 2, 3 (establishing the EPIC surcharge and ordering the electric IOUs to collect EPIC funds from their ratepayers in the same manner as the expiring system benefits charge associated with Public Utilities Code Section 399.8).

[18] D.12-05-037 at OP 1.

[19] D.15-04-020at Appendix B, Table 5.

[20] *See* AL 2321-E, filed and effective December 22, 2011 (establishing SDG&E's EPIC surcharge and associated EPIC Balancing Account); Advice Letter 2375-E, filed and effective June 22, 2012 (revise its EPIC Balancing Account to align with SDG&E's 8.8% share of authorized funding beginning January 1, 2013); and Advice Letter 2402-E filed October 1, 2012 and effective January 1, 2013 (revising SDG&E's electric PPP rates effective January 1, 2013 in accordance with OP 1 & 7 of D.12-05-037).

[21] D.15-04-020 at 35.

[22] Figures may differ slightly from those in Table 1 due to rounding.

1. SDG&E's Estimated Collections Reflects Estimated CPI Adjustments

The Consumer Price Index-based adjustment to EPIC collections commencing January 1, 2018 was previously ordered by the Commission in D.12-05-037.[23] The same decision specifically outlines how the adjustment will be calculated, *i.e.*, by "the average change in the Consumer Price Index, specifically the Consumer Price Index for Urban Wage Earners and Clerical Workers for the third quarter, for the previous three years."[24]

SDG&E cannot calculate the rate adjustment at the time of this filing because the Consumer Price Index for Urban Wage Earners and Clerical Workers for the third quarter of 2017 will not be made public until late October 2017. As a placeholder for this Application, SDG&E has used an estimated 2.065% inflation adjustment. The estimated inflation adjustment is based on the Urban Wage Earners and Clerical Workers CPI annual growth rate for the past three years (2014 – 2016), compounded by 3 years.

The EPIC funds are collected as part of the electric PPP bill component. SDG&E files a Tier 2 advice letter October 1 of each year for PPP rates effective the following year.[25] Then in late December every year, SDG&E files the Consolidated Filing to Implement January 1 Electric Rates, which incorporates the (usually by then approved) Tier 2 advice letter concerning PPP rates.

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[23] D.12-05-037 at OP 7.

[24] D.12-05-037 at OP 7 ("The total collection amount [of EPIC] shall be adjusted on January 1, 2015 and January 1, 2018 commensurate with the average change in the Consumer Price Index, specifically the Consumer Price Index for Urban Wage Earners and Clerical Workers for the third quarter, for the previous three years."). The Decision is silent on the appropriate regulatory mechanism that should be employed to incorporate the escalated amount into rates.

[25] Pursuant to D.03-04-027at OP 2, SDG&E must file by October 1 of each year an advice letter requesting to apply to the electric PPP rate effective January 1 of the following year: (1) the net amortization component of electric PPP account balances; and (2) the Commission's currently authorized program budget revenue requirements for the PPPs.

To effectuate the rate adjustment to EPIC collections on January 1, 2018, SDG&E will file its Tier 2 advice letter around October 1, 2017 for PPP rates effective January 1, 2018, as is its normal practice. The Consumer Price Index for Urban Wage Earners and Clerical Workers for the third quarter of 2017 should be available in mid to late October. Using this information, SDG&E will provide this calculated updated EPIC escalation adjustment with its year-end electric consolidated filing, filed at the end of December 2017, to implement January 1, 2018 rates. This is the same process SDG&E followed when it adjusted its EPIC collection amount on January 1, 2015.[26]

B. SDG&E's Estimated Collections Reflects Return of Accumulated Interest

D.15-04-020 states that "[a]ll interest on 2012-2014 and 2015-2017 funds remaining at the end of the 2015-2017 cycle shall be returned to ratepayers."[27] The Decision continues, explaining that "[i]nterest shall be returned to ratepayers in the form of reduced collections for the subsequent program period."[28] "Administrators' 2018-2020 investment plans shall identify the amount of accumulated interest expected to reduce collections in that period, and their proposed budgets should be adjusted accordingly."[29]

Table 3 above shows the expected collections for EPIC-3 during the period from 2018-2020 adjusted by the return of accumulated interest. SDG&E anticipates that approximately $343k in interest will have accrued in the SDG&E EPICBA by the end of the 2015-2017 EPIC-2

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[26] SDG&E AL 2652-E-A (filed October 8, 2014); effective January 1, 2015. *See also* D.15-04-020 at Appendix B, p. 6.

[27] D.15-04-020 at 37 & OP13 ("All interest on 2012-2014 and 2015-2017 Electric Program Investment Charge funds remaining at the end of the 2015-2017 cycle shall be returned to ratepayers.").

[28] D.15-04-020at 37.

[29] D.15-04-020at OP15.

cycle (December 31, 2017).[30] The SDG&E collections are adjusted downward by $343k as a credit for accumulated interest. This adjustment is an estimate based on the most recent data available. It is subject to a true-up process once better data becomes available.

VI. SDG&E'S EPIC-3 PLAN SHOULD BE APPROVED AS REASONABLE, APPROPRIATE, AND IN THE INTEREST OF RATEPAYERS

In D.12-05-037, the Commission mandates that any program funded through EPIC must, first and foremost, be able to demonstrate its "potential to produce electricity ratepayer benefits, defined as promoting greater reliability, lower costs, and increased safety."[31] In addition, it must use various complementary and statutory principles to guide the plan's development and ensure the result is "just and reasonable to ratepayers."[32]

The SDG&E EPIC-3 Plan is fully consistent with and responsive to the requirements outlined in D.12-05-037. The SDG&E EPIC Plan has the potential to provide ratepayers with greater reliability, lower costs, and increased safety by modernizing the electric grid.[33] In addition, the EPIC Plan aligns with the complementary principles outlined in D.12-05-037, such as the efficient use of ratepayer monies and support for GHG emission reduction policies.[34] It

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[30] As of March 31, 2017, the EPICBA had accrued $65k in interest. The interest rate for the SDG&E EPICBA is the previous month's 3-month commercial paper rate. EPICBA: http://regarchive.sdge.com/tm2/pdf/ELEC_ELEC-PRELIM_EPICBA.pdf

[31] D.12-05-037 at FOF 1.

[32] *Id*. at 20 & OP 2.

[33] *See* EPIC Plan (provided as Attachment A) at Sections 4.1 and 7.

[34] *See* i*d*. at Section 7.

also meets the statutory criteria outlined in sections 740.1 and 8360.[35] All seven projects map to the applicable sections of the electric utility value chain.[36]

VII. SDG&E'S EPIC PLAN FULFILLS REQUIREMENTS OF PAST EPIC DECISIONS

A. In Accordance with D.12-05-037, SDG&E Has Collaborated and Consulted with Others During Plan Development

The Commission requires extensive coordination among the EPIC Administrators, as well as consultation with interested stakeholders. The Commission has stated that these collaborations between the EPIC Administrators are done under protection of the State Action Immunity doctrine from antitrust liability.[37] D.12-05-037 encourages the four EPIC Administrators to "offer a coordinated approach to clean energy RD&D"[38] through their triennial EPIC plans "to ensure there is no duplication of effort."[39] D.12-05-037 also requires that the EPIC Administrators consult with stakeholders at specific times during the scoping and plan development process. As further described in the SDG&E EPIC Plan, SDG&E has satisfied these requirements.[40]

1. Coordination with Other EPIC Program Administrators

SDG&E has fulfilled the requirements of D.12-05-037 to coordinate with the other EPIC Administrators through reasonable and constant collaboration throughout the plan development process. Starting in Spring 2012, SDG&E and the other EPIC Administrators instituted the

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[35] *Id*. at Section 8.

[36] *Id*. at Sections 4.3-4.9. The SDG&E's EPIC-3 Plan maps to all sections of the utility value chain except for two: "Generation" (because the IOU Administrators are prohibited from funding generation projects through EPIC) and "Grid Operations/ Market Design."

[37] D.13-11-025 at 108-110.

[38] D.12-05-037 at FOF 9.

[39] *Id*. at 40.

[40] *See* EPIC Plan (provided as Attachment A) at Section 5.

tradition of frequent, often weekly, conference calls and the occasional working sessions to discuss the development of EPIC-1 Plans and, after Commission approval in November 2013, plan implementation. The EPIC Administrators continued these calls when developing and implementing the EPIC-2 Plans. The practice of frequent coordination between the four EPIC Administrators has continued during the EPIC-3 Plan development. During these calls and working sessions, the EPIC Administrators coordinate their individual EPIC plans to prevent duplication, ensure consistent EPIC program implementation and administration, and determine if there are potential collaboration opportunities. These meetings have allowed for open discussions and an exchange of knowledge among the EPIC Administrators to ensure an effective common approach to EPIC-3.

2. Consultation with Stakeholders

SDG&E's efforts to inform and involve interested stakeholders in its EPIC-3 Plan development have been reasonable and in accordance with D.12-05-037. The Commission has stated its vision that the EPIC Administrators would hold scoping workshops in Winter 2016-17, and propose their EPIC Plans to stakeholders in March 2017 before filing the Plans on May 1, 2017.[41] SDG&E fully satisfied these requirements by engaging in the mandatory consultations with stakeholders, as well as participating in voluntary consultations with the Electric Power Research Institute ("EPRI").

On January 30, 2017, SDG&E hosted a one-day workshop with the EPRI and the other EPIC Administrators. The purpose of the workshop was to conduct a gaps analysis on the proposed content of the EPIC plans to assure the projects were filling key gaps in RD&D in a global context.

[41] D.12-05-037 at 31.

On March 9 and 24, 2017, the IOU Administrators held joint public scoping workshops. At the workshops, the IOUs summarized their planning and coordination process and presented examples of projects under consideration for EPIC-3 cycle. As required by D.12-05-037,[42] SDG&E presented an overview of its draft EPIC-3 Plan to stakeholders at the workshops. SDG&E outlined its draft EPIC-3 Plan with its seven projects and described in detail three of the projects. The slides were also posted on SDG&E's website for public review.[43] Stakeholders were encouraged to submit comments during and after the workshop. Both CEC and Commission Staff participated in the workshops.

SDG&E found the stakeholder feedback useful and incorporated the stakeholders' input into the EPIC Plan, when appropriate. The feedback SDG&E received from stakeholders regarding its EPIC Plan, as well as stakeholder comments made generally to the IOU Administrators but also relevant to SDG&E, is described in the attached SDG&E EPIC Plan, along with SDG&E's responses to the feedback.[44]

B. The SDG&E EPIC Plan Provides a Sufficient Summary of SDG&E's Approved EE and DR Programs

In accordance with D.12-05-037, EPIC plans must provide informational summaries of RD&D efforts underway through approved Energy Efficiency ("EE") and Demand Response ("DR") portfolios. In D.13-11-025, the Commission instructed that "[t]he IOUs Administrators should provide more thorough informational summaries of their RD&D activities undertaken as part of their approved Energy Efficiency and Demand Response portfolios in their future EPIC investment plan applications. Each IOU investment plan application should include an appendix

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[42] D.12-05-037 at 31.

[43] SDG&E, EPIC, http://sdge.com/regulatory-filing/3749/electric-program-investment-charge-epic.

[44] *See* EPIC Plan (provided as Attachment A) at 5.3.

summarizing the RD&D activities undertaken as part of their approved Energy Efficiency and Demand Response portfolios, and this appendix should describe each RD&D project, including the purpose, funding, deliverables and progress to date."[45] The SDG&E EPIC Plan fulfills this requirement by providing Appendices A and B, summaries of the RD&D activities undertaken as part of SDG&E's approved Energy Efficiency and Demand Response portfolios.

C. SDG&E Will Implement Intellectual Property Methodologies in Accordance with D.13-11-025

EPIC plans presented for Commission approval are required to describe intended IP methodologies.[46] The EPIC IOU Administrators briefed IP issues in the last EPIC application proceedings. The IOU Administrators commented that the various ways that IP may be developed during an EPIC project necessitate that the IOU Administrators are allowed flexibility in how they approach EPIC-funded IP. In D-13-11-025 and D.15-04-020, the Commission responded by outlining numerous methodologies and requirements for IP developed with EPIC funds.[47]

The execution of SDG&E's EPIC-1 and EPIC-2 Plans have not reached a stage where SDG&E can evaluate whether the Commission's IP are pragmatic or sufficiently flexible in the context of an EPIC project with contractors. Therefore, pending any changes to the Commission's IP requirements through this proceeding, SDG&E will employ IP methodologies in accordance with D.13-11-025 and D.15-04-020 for those projects in its EPIC-3 Plan.

VIII. REQUESTED RELIEF

SDG&E respectfully requests that the Commission issue a decision:

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[45] D.13-11-025 at COL 59.

[46] D.12-05-037 at 78-79.

[47] D.13-11-025 at OPs 28 & 31-34; D.15-04-020 at OPs 18 &19.

1. Finding that SDG&E's EPIC-3 Application and Plan are in compliance with the requirements of past EPIC decisions (*i.e.*, D.12-05-037, D.13-11-025 and D.15-04-020);

2. Approving the SDG&E EPIC-3 Plan as reasonable, appropriate and in the interest of electric utility ratepayers;

3. Rendering other Findings of Fact, Conclusions of Law, and issuing Orders consistent with the foregoing requests; and

4. Any other relief as is necessary and proper.

IX. STATUTORY AND PROCEDURAL REQUIREMENTS

A. Rule 2.1 (a) – (c)

In accordance with Rule 2.1 (a) – (c) of the Commission's Rules of Practice and Procedure, SDG&E provides the following information.

1. Rule 2.1 (a) - Legal Name

SDG&E is a corporation organized and existing under the laws of the State of California. SDG&E is engaged in the business of providing electric service in a portion of Orange County and electric and gas service in San Diego County. SDG&E's principal place of business is 8330 Century Park Court, San Diego, California 92123. SDG&E's attorney in this matter is Emma D. Salustro.

2. Rule 2.1 (b) - Correspondence

Correspondence or communications regarding this Application should be addressed to:

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8330 Century Park Court, CP32F
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3. Rule 2.1 (c)

a. Proposed Category of Proceeding

The previous two EPIC triennial proceedings, A.12-11-001 et al. and A.14-04-034 et al., were categorized as "ratesetting" proceedings.[48] SDG&E proposes that this proceeding also be categorized as a "ratesetting" proceeding.

b. Proposed Schedule and Issues to be Considered

SDG&E does not believe that approval of this Application will require hearings. The previous two EPIC triennial proceedings, A.12-11-001 et al. and A.14-04-034 et al., did not require testimony or evidentiary hearings. SDG&E has provided ample supporting information to create a record upon which the Commission may grant the relief requested. In addition, SDG&E has presented the draft SDG&E EPIC Plan to interested stakeholders, including Commission Staff, several times during the Plan's scoping and development during workshops, and has incorporated relevant feedback into the SDG&E EPIC-3 Plan.

[48] *See*, *e.g.*, D.15-04-020 at 56.

Therefore, SDG&E proposes the following schedule:

PROPOSED SCHEDULE – NO HEARINGS	
ACTION	**DATE**
Application filed	May 1, 2017
Daily Calendar Notice	May 2, 2017
Response/Protests	June 2, 2017
Reply to Response/Protests	June 12, 2017
Prehearing Conference	June 20, 2017
Scoping Memo Issued	June 30, 2017
Intervenor Testimony	July 31, 2017
Concurrent Rebuttal Testimony	August 22, 2017
Concurrent Opening Briefs	September 22, 2017
Concurrent Reply Briefs	October 6, 2017
Proposed Decision	TBD

The issues to be considered are described in this Application. In the scoping memos for the EPIC-1 and EPIC-2 plans, the Commission noted that the major issue to be considered is whether the EPIC plans adequately comply with the requirements of previous EPIC decisions.[49] The scope of this proceeding should be identical.

4. Rule 2.1 (d) – Safety[50]

SDG&E is committed to safety. Based on current information, SDG&E's EPIC-3 Plan will not result in any adverse safety impacts on the facilities or operations of SDG&E. Moreover, if its EPIC-3 Plan is approved, SDG&E intends to partner with skilled labor and vendors that demonstrate the necessary and applicable safety training, knowledge and/or

[49] A.12-11-001, Scoping Memo at 7-11 (issued January 7, 2013); A.14-04-034, Scoping Memo at 4-7 (issued July 28, 2014).

[50] In D.16-01-017, the Commission amended Rule 2.1 to require all applications to include a detailed showing of relevant safety considerations.

certification. Bidders' proposals are examined to assess the proposer's approach for safety in performing the project work. In addition, SDG&E will comply with all applicable current safety laws, rules and procedures, including SDG&E's internal policies.

B. Rule 2.2 – Articles of Incorporation

A copy of SDG&E's Restated Articles of Incorporation as last amended, presently in effect and certified by the California Secretary of State, was filed with the Commission on September 10, 2014 in connection with SDG&E's Application No.14-09-008, and is incorporated herein by reference.

X. SERVICE

SDG&E will serve this Application and its attachments on parties to the service list for R.11-10-003, the most recent EPIC proceeding (A.14-04-034), and all parties to the most recent general rate cases for SDG&E (A.14-11-003), Pacific Gas and Electric (A.15-09-001), and Southern California Edison (A.16-09-001). Hard copies will be sent by overnight mail to the Assigned Administrative Law Judge in each proceeding and Chief ALJ Karen Clopton.

XI. CONCLUSION

WHEREFORE, SAN DIEGO GAS & ELECTRIC COMPANY requests that the Commission grant SDG&E's Application as described herein.

Respectfully submitted this 1st day of May 2017.

By: /s/ Emma D. Salustro
Emma D. Salustro

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SAN DIEGO GAS & ELECTRIC COMPANY

By: /s/ John Jenkins
John Jenkins
San Diego Gas & Electric Company
Vice President – Electrical Engineering & Construction

OFFICER VERIFICATION

OFFICER VERIFICATION

John Jenkins declares the following:

I am an officer of San Diego Gas & Electric Company and am authorized to make this verification on its behalf. I am informed and believe that the matters stated in the foregoing **APPLICATION OF SAN DIEGO GAS & ELECTRIC COMPANY (U 902-E) FOR APPROVAL OF ELECTRIC PROGRAM INVESTMENT CHARGE TRIENNIAL PLAN FOR YEARS 2018-2020** are true to my own knowledge, except as to matters which are therein stated on information and belief, and as to those matters, I believe them to be true.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed on May 1, 2017 at San Diego, California.

By: /s/ John Jenkins
John Jenkins
San Diego Gas & Electric Company
Vice President – Electrical Engineering & Construction

Attachment A

SDG&E Third EPIC Triennial Investment Plan 2018-2020

Third EPIC Triennial Investment Plan: 2018-2020 (EPIC-3)

San Diego Gas & Electric

May 1, 2017

1 Executive Summary of the SDG&E Third Triennial EPIC Investment Plan

The SDG&E Third Triennial EPIC Investment Plan ("the SDG&E EPIC-3 Plan" or "EPIC-3 Plan") is the third of SDG&E's three required EPIC plans and covers funding years 2018 through 2020. The SDG&E EPIC-3 Plan is composed of seven individual proposed projects. The SDG&E EPIC Plan was developed by SDG&E to ensure alignment with the needs of SDG&E's customers, and refined through Commission-ordered collaboration with the other EPIC Administrators, consultations with stakeholders, and an industry gaps analysis, conducted in collaboration with the Electric Power Research Institute ("EPRI").

The portfolio of seven projects aims to provide electric utility customers with the Commission-encouraged benefits of lower costs, greater reliability and/or increased safety.[1] In addition, the seven projects align with various California energy policies, goals and statutory requirements.

2 Background

The California Public Utilities Commission ("Commission") established the Electric Program Investment Charge ("EPIC") in Decisions ("D.") 11-12-035 and 12-05-037 to provide public interest investments in research and development of clean energy technologies and approaches for the benefit of California's investor-owned utility ("IOU") electric customers.[2] San Diego Gas & Electric Company ("SDG&E"), Pacific Gas and Electric Company ("PG&E"), and Southern California Edison Company ("SCE"); collectively, the "IOUs," or "EPIC IOU Administrators", and the California Energy Commission ("CEC"; collectively with the IOUs, the "EPIC Administrators") are required to propose plans to the Commission for the use of EPIC funds every three years.[3]

3 Framework for Developing the SDG&E EPIC Plan

The IOU Administrators collaborated during the planning for the first EPIC triennial cycle to create the non-binding IOU Working EPIC Framework ("Working Framework"). This framework was used again in the second triennial cycle and has now been updated and used during the third triennial planning cycle. The updated Working Framework is shown below in Figure 1.

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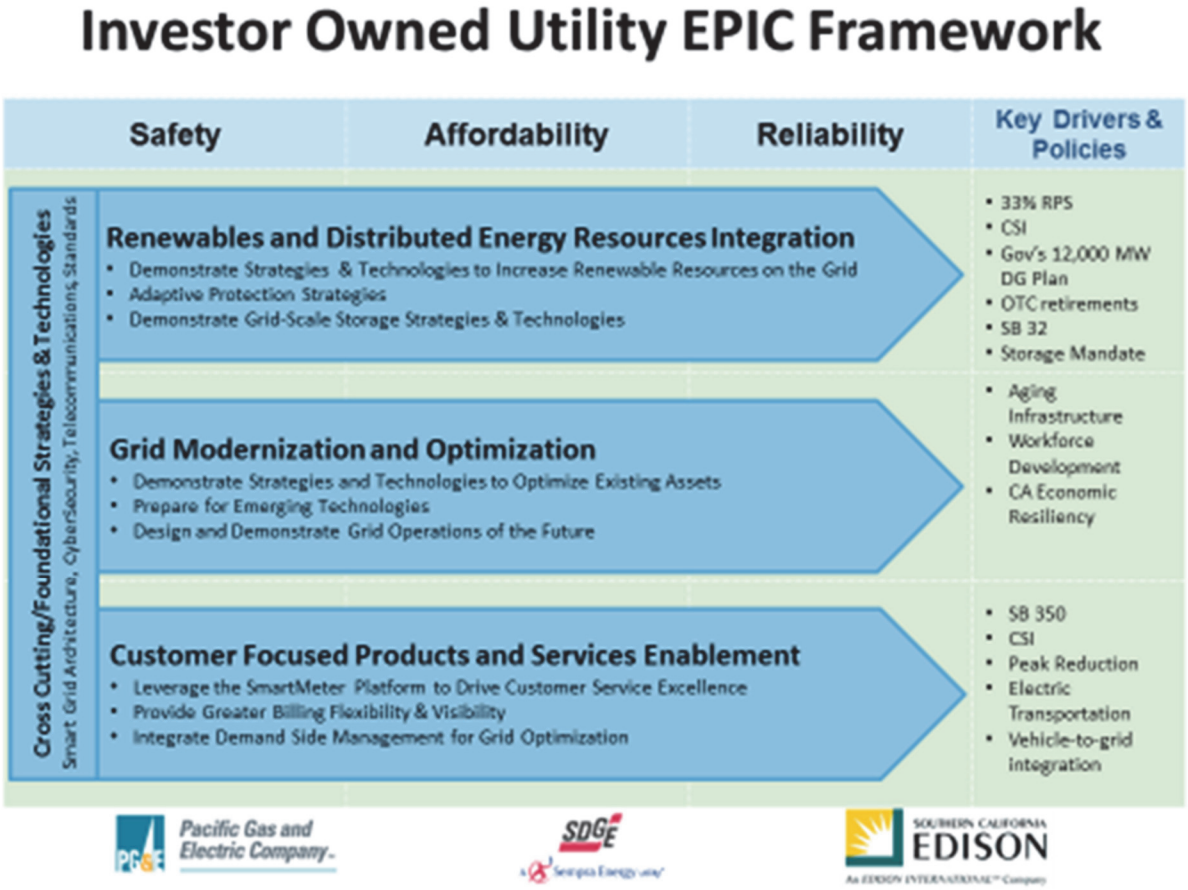
1 D.12-05-037 at 12

2 *Id*. at 2.

3 *Id*. at 31 & OP 11.

Figure 1. Investor Owned Utility EPIC Framework



The Working Framework is not intended to be a legally-binding document within which the IOU Administrators' EPIC programs are limited, but rather a guiding reference that expresses the interplay of the various pressures on today's electric energy sector, including regulatory and legislative requirements and their underlying policy goals, Public Utilities Code section 8360 requirements, the electricity system value chain, and industry gaps.

3.1 Working Framework Categories

The Working Framework outlines four possible categories in which the IOU Administrators should focus their EPIC projects:

A. Renewable and Distributed Energy Resource Integration
B. Grid Modernization and Optimization
C. Customer Focused Products and Services Enablement
D. Cross Cutting/Foundational Strategies and Technologies

These four categories are described below in more detail. All four categories strive to encourage the EPIC Administrators to advance EPIC projects that are designed to help

provide electric IOU customers the benefits of greater reliability, lower costs, and/or increased safety, while simultaneously helping to provide other benefits related to greenhouse gas emissions mitigation, the California Loading Order, low-emission vehicles/transportation issues, economic development, the efficient use of customer monies, and other general societal benefits.

3.1.1 Category A: Renewable and Distributed Energy Resource Integration

California's clean energy goals are the primary policy drivers for this category of potential EPIC programs. With the passing of SB 350, by 2030, California utilities are required to have (1) reduced greenhouse gas emissions to 40 percent below 1990 levels;[4] (2) purchased or produced enough California-eligible renewable energy to meet 50% of customer needs;[5] and (3) doubled statewide energy efficiency savings in retail end uses.[6] In addition, California utilities continue to be strongly encouraged to reduce petroleum use in vehicles by 50%,[7] incorporate energy storage into the electricity grid,[8] and interconnect 12,000 MW of locally-produced renewable generation, at the distribution level.[9] The California utilities are further engaged in helping develop a regulatory framework[10] and investment plans[11] to accommodate higher distributed energy resource deployment.

This Working Framework category, *Renewable and Distributed Energy Resource Integration*, encompasses potential EPIC projects designed to help California and its electric utility customers:

1. Safely, reliably and affordably attain the State's clean energy policy goals at the least cost/best fit;
2. Maintain various required balancing area standards (e.g., frequency, voltage and balance) and utility standards (e.g., voltage and harmonics);

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4 Cal. Pub. Util. Code § 454.52(a)(1)(A) (2017).

5 Cal. Pub. Util. Code § 399.15(b)(2)(B) (2017).

6 Cal. Pub. Res. Code § 25310(c)(1) (2017).

7 *See* "Cutting Petroleum Use in Half by 2030", California Air Resources Board, available at: https://www.arb.ca.gov/newsrel/petroleum_reductions.pdf (discussing California's 2030 Climate Commitments).

8 *See* Cal. Pub. Util. Code §§ 2835-2839.

9 Clean Energy Jobs Plan" at 3, California Office of Governor Brown, *available at*: https://www.gov.ca.gov/docs/Clean_Energy_Plan.pdf (issued 2011).

10 *See* R.14-10-003, Integrated Distributed Energy Resources OIR.

11 *See* A.15-07-003, Application of SDG&E for Approval of Distribution Resource Plan.

3. Demonstrate California's leadership in new technologies and grow the State's economy by developing and investing in leading-edge technology companies;
4. Develop and maintain a skilled workforce versed in the newest technologies; and
5. Strive for minimal rate increases necessary to de-carbonize the utility systems.

3.1.2 Category B: Grid Modernization and Optimization

Utility system infrastructure (sometimes referred to as "the grid") is continuously being adapted to meet modern needs as new technology becomes available and is integrated into the grid. New methods, technology, applications, integrated systems, and tools are constantly in demand to help utilities manage and maintain existing grid assets and to enable and integrate the "next generation" of assets, which will keep the increasingly complex grid system operating safely, reliably, and cost-efficiently in the future. The Commission has several proceedings that support the electric IOUs in these endeavors.[12]

This Working Framework category, *Grid Modernization and Optimization*, encompasses potential EPIC projects designed to help California and its electric utility customers:

1. Integrate a multitude of new technologies into the power system so that they operate harmoniously together and provide maximum benefits to customers;
2. Protect against cybersecurity and critical infrastructure threats;
3. Safely, reliably and affordably integrate technologies that help to achieve the State's energy goals;
4. Demonstrate California's leadership in new technology;
5. Develop and maintain a skilled workforce versed in the newest technologies;
6. Ensure that customers enjoy a smooth upgrade experience; and
7. Ensure that IOUs are making the best technology choices in terms of functionality and economics.

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[12] The Commission recently held a workshop to "inform the development of a . . . framework to evaluate grid-modernization investments…". *See* Grid Modernization Investment Framework Workshop – Agenda, *available at*: www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442452338 (January 24, 2017). Issues related to grid modernization were also discussed in R.14-08-013, *Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769*. The utilities continue to submit smart grid annual deployment plan updates, pursuant to R.08-12-009, *Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's, own Motion to Actively Guide Policy in California's Development of a Smart Grid System*.

3.1.3 Category C: Customer Products/Services Enablement and Integration

State policies and related technologies continue to drive California energy customers' participation in the energy sector, such as through smart meters[13], electric vehicles ("EV")[14], distributed generation systems (including residential solar and battery storage)[15], demand response and demand management methods[16], and zero net energy ("ZNE") homes.[17] Customers have the potential to evolve from simply being consumers of electricity to being "prosumers" (producers and consumers) of electricity. With the help of new technologies, prosumers can actively participate by supplying power from their own distributed energy resources to the grid and by using energy management systems to operate their energy devices in an optimal manner. Energy storage has received increased attention in this area in recent years.

This Working Framework category, *Customer Products/Services Enablement and Integration*, encompasses EPIC projects designed to help California and its electric utility customers:

1. Implement California's energy policies;
2. Develop and maintain a skilled workforce versed in newest technologies;
3. Continue to provide reliable power to consumers; and
4. Provide customers with opportunities to better manage their own energy costs and to become producers of electricity.

3.1.4 Category D: Cross Cutting Strategies and Technologies

This Working Framework category includes issues, such as communication systems, physical and cyber system security, system architecture and system data management, that cut across the other three Working Framework categories. This broad category mirrors the goal of developing the architecture for networked automation of power system functions by overlaying an advanced communication infrastructure (based on emerging interoperability standards) on an increasingly complex electrical system. The

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[13] The Commission estimates that nearly 60 million smart meters should be in place by 2020. *See* The Benefits of Smart Meters, California Public Utilities Commission, *available at*: http://www.cpuc.ca.gov/General.aspx?id=4853.

[14] *See, e.g.*, Transportation Electrification Activities Pursuant to Senate Bill 350, *available at*: http://www.cpuc.ca.gov/sb350te/.

[15] *See* R.12-11-005, OIR Regarding Policies, Procedures and Rules for the California Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues; *see also* A.15-07-003, Application of SDG&E for Approval of Distribution Resource Plan.

[16] *See* R.13-09-011 (demand response OIR); *see also* A.17-01-019 (demand response programs).

[17] *See* California Energy Efficiency Strategic Plan: New Residential Zero Net Energy Action Plan 2015-2020 (June 2015).

adoption of available, applicable and cost-effective standardized communication protocols is necessary to enable automatable devices to “plug and play” in the new advanced communication infrastructure and avoid costly engineering work every time a new device is added.

This Working Framework category, *Cross Cutting Strategies and Technologies*, encompasses EPIC programs designed to provide California and its electric utility customers with foundational and cross-cutting utility system infrastructure, promote standards adoption, and enable facilities and support the continuous integration of a growing number of automated devices into power system operations.

Projects within this category vary and may include, but are not limited to:

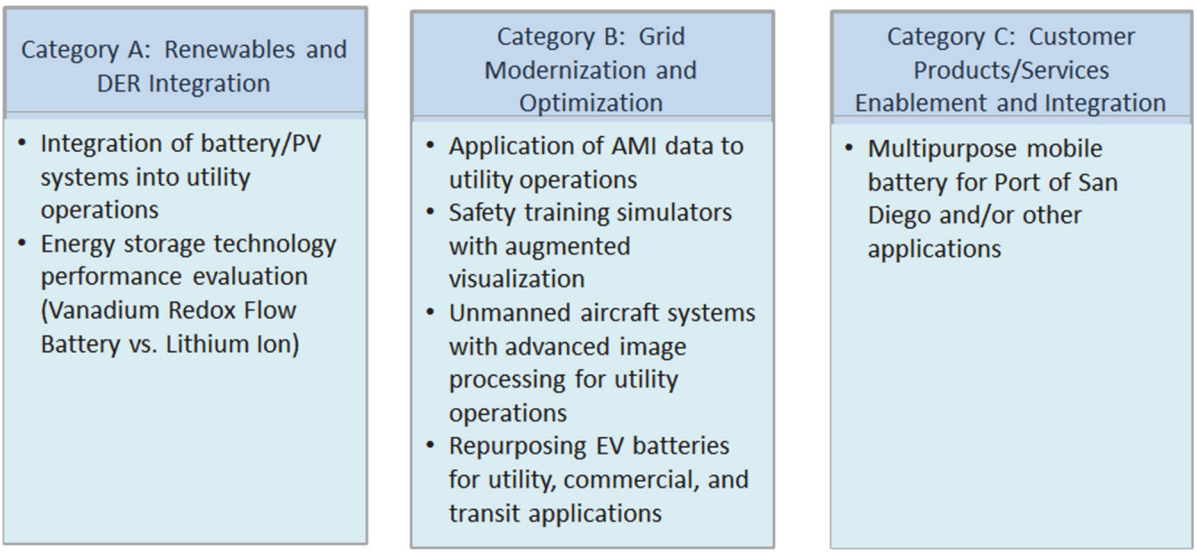
1. Testing system architecture, components, subsystems, and standards for advanced power system infrastructure;[18]
2. Demonstrating cybersecurity protections on IOUs’ power systems; and
3. Demonstrating data analytics technologies that use increased data volumes without reducing processing speeds.

3.1.5 Summary of SDG&E EPIC-3 Projects by IOU Working Framework Category

Figure 2 shows where the proposed seven SDG&E EPIC-3 projects fall within the IOU Working Framework categories.

[18] For example, demonstrations of solutions for achieving integration and interoperability of electrical and communication infrastructure, including network operation of components currently operated autonomously, into a strategically automated system, would fall under this category.

Figure 2[19]



As shown in Figure 2, SDG&E has planned projects in three of the four Working Framework categories. A detailed description of SDG&E's project portfolio for its EPIC-3 Plan follows in Section 4.

4 SDG&E's EPIC-3 Portfolio

4.1 SDG&E EPIC-3 Vision and Proposed Projects

SDG&E's EPIC-3 portfolio is composed of seven diverse projects:

- Project 1: Integration of Battery and Photovoltaic Systems into Utility Operations
- Project 2: Energy Storage Performance Evaluation
- Project 3: Application of Advanced Metering Infrastructure Data to Advanced Utility System Operations
- Project 4: Safety Training Simulators with Augmented Visualization
- Project 5: Unmanned Aircraft Systems with Advanced Image Processing for Electric Utility Inspection and Operations
- Project 6: Repurposing Post Electric Vehicle Batteries for Utility, Commercial, and Mass Transit Applications

[19] Some projects map to more than one area in the Working Framework, so they are shown in the category to which the mapping is strongest.

- Project 7: Demonstration of Multipurpose Mobile Battery for Port of San Diego and/or Other Applications

The seven proposed projects are described in detail in this section. In addition to fulfilling the EPIC requirement of having the potential to provide electric utility customers with the Commission-encouraged benefits of lower costs, greater reliability and/or increased safety, the portfolio of projects reflects a new emphasis by both SDG&E and the Commission on safety issues and battery-related topics.

4.2 SDG&E's EPIC-3 Plan Development and Project Execution

SDG&E developed its EPIC-3 Plan in accordance with the requirements of D.12-05-037. When evaluating various projects to propose in EPIC-3, SDG&E considered both the needs of its customers and the company. It also looked at potential extensions of SDG&E EPIC-1 and EPIC-2 projects. It also considered feedback from the other EPIC Administrators, external stakeholders and EPRI.

After Commission approval, in general, the sequence of work for each project will follow the normal sequence for a demonstration activity. The project will start with a planning phase, during which the focus for each demonstration will be determined, including a project-specific scope and metrics, equipment needs, tests to be performed, analyses to be performed, staffing requirements, contractor and procurement requirements, equipment and equipment procurement requirements, documentation requirements, and equipment disposition requirements. The chosen focus will emphasize the highest priority needs in the project area at the time and will be limited by available funding.

Once the specific project details are developed, a final coordination process will be done to identify any opportunities for collaboration with other EPIC Administrators. The EPIC Administrators will also continue to coordinate during project execution to ensure that duplication is avoided.

The EPIC-3 projects are not duplicative of any other RD&D projects currently known to SDG&E.

4.3 Project 1: Integration of Battery and Photovoltaic Systems into Utility Operations

Primary Area of IOU Framework: Renewables and Distributed Energy Resources Integration

Objective: This project will demonstrate control and communication options for integrating battery, photovoltaic and other distributed energy resource ("DER") system combinations into utility distribution system operations. The project will identify best practices and make recommendations regarding which practices should be adopted for commercial use. The results will be documented in a comprehensive report for use by utilities and other stakeholders.

Concern, Gap, or Problem to be Addressed: The increased use of distributed generation, energy storage, and controllable electronic devices in the power system will require more sophisticated communication and control infrastructure to safely and successfully operate the power system. A properly designed infrastructure can increase the benefits of coordinated use of these new resources for customers. Without the improved infrastructure for strategically using the new resources, the power system's performance could be suboptimal and the quality of service to customers could be compromised by the growing proliferation of new devices in the system.

Description of Technology or Strategy to be Demonstrated: This project will consist of pre-commercial demonstration of different applications of photovoltaic ("PV")/storage system combinations in differing circuit situations, with a focus on the communication, control, and operating modes of the PV and storage devices, including those realized through emerging multifunctional inverters (i.e., "smart" inverters). Other DER types may also be demonstrated depending on which operating solutions are demonstrated. The demonstration equipment will be piggybacked on existing PV and storage devices already in the system. Interoperability with customer systems and electric vehicle infrastructure may also be considered. This project may include, but will not be limited to, the following activities:

1. Demonstrate that capacity firming can be achieved using high speed communications between an energy storage device and a PV system that does not share the same point of common coupling. This would include pre-commercial demonstrations of high speed radios between energy storage and renewable resources; verification that the signal can be received and the system operates within 100 milliseconds; and technical evaluations of the communication system and feasibility for widespread adoption. The Canyon Crest Academy site has been tentatively selected to host the demonstration.

2. Perform a pre-commercial demonstration of a microgrid using multiple storage and renewable resource assets. For purposes of this project, a microgrid is defined as an intentionally islandable circuit or group of circuits. Interoperability issues, additional engineering, and equipment needed to develop a functional microgrid as a retrofit to existing infrastructure would be investigated. The "stackable" benefits of multiple uses of the storage at different times in their duty cycle would be studied. The project location will be the Pala energy storage yard or suitable alternative.

3. Demonstration of communication protocols for integration of DER, building on earlier work in this area done in EPIC-1 and EPIC-2. This work could include IEC 61850 or other important open-standard protocols.

4. Demonstrating the integration of the smart transformer and renewable meter adapter ("RMA") into the monitoring and control infrastructure.

A final determination of project's demonstration focus, as well as the development of the project's specific scope and metrics, will be made in the project planning phase.

Applicable Electricity Value Chain Elements: Distribution (primary) and demand-side management (secondary).

Potential Benefits: This project is designed to help increase the roles that intermittent renewable energy resources can play in future energy supply by enabling more strategic interoperability of PV and battery systems. The battery systems are needed to store energy and use it to help smooth out the intermittence of solar resources and to shift energy from off-peak to on-peak times. This project will explore different application scenarios in which batteries may be used for multiple duties (ranging from short-term smoothing of solar resource output, to voltage and reactive power management and other grid support functions, to longer-term peak shifting). Stacking the benefits from using the PV/battery combinations strategically for different things at different times will increase the economic effectiveness of these resources. It could also help contribute to a more widespread adoption of renewable energy with a resulting contribution to greenhouse gas reduction. The project will demonstrate alternative PV/battery application scenarios, identify the preferred application stacking approaches, and test communication and control infrastructure needed to achieve successful commercial adoption of the preferred approaches. The project results will also be useful as components of solutions needed for intentionally islanding circuits in the future to create so-called "microgrids".

4.4 Project 2: Energy Storage Performance Evaluation

Primary Area of IOU Framework: Renewables and Distributed Energy Resources Integration

Objective: The objective of this project is to perform operational testing and staged tests of Vanadium Redox Flow ("VRF") batteries and lithium ion batteries through a test plan targeted at evaluating performance characteristics and understanding ramifications for integrating both types of batteries with power system infrastructure and operations. The test plan will be designed to provide a comparative basis for the two types of batteries.

Concern, Gap, or Problem to be Addressed: Lithium ion and VRF batteries offer two different options for widespread use in future energy storage systems ("ESS"). They have innate differences, such as the length of discharge time available. An evaluation and comparison of the two types of battery technologies using a consistent demonstration basis is needed to guide utilities and other stakeholders on the merits and demerits of each battery type in major applications.

Description of Technology or Strategy to be Demonstrated: A performance evaluation will be conducted for the VRF and lithium ion battery systems using a standardize test protocol. This demonstration will provide a comparative basis for understanding the batteries' performance characteristics relative to each other. The

starting point will be the test protocols proposed by Sumitomo for VRF systems. The demonstration work will be piggybacked on existing VRF and lithium ion assets in the SDG&E system.[20]

Applicable Electricity Value Chain Elements: Distribution (primary) and Demand-Side Management (secondary).

Potential Benefits: This project is designed to help create the knowledge needed to make strategic decisions about what applications and system locations are best suited for commercial use of the two types of battery technology. For example, in what application situations is one type of battery better than the other type. The project will provide a basis for future decisions on commercial battery deployment and what the installation and operation requirements would be for the two battery types.

4.5 Project 3: Application of Advanced Metering Infrastructure Data to Advanced Utility System Operations

Primary Area of IOU Framework: Grid Modernization and Optimization
Objective: The objective of this project is to demonstrate capabilities for leveraging SDG&E's advanced metering infrastructure ("AMI") system with its 1.4 million electric meter endpoints to provide actionable secondary voltage data and analysis to SDG&E staff and other prospective users.

Technology or Strategy to be Demonstrated: This foundational project will demonstrate two critical capabilities of the AMI system: as a voltage sensor network and as a phase identification tool. As a voltage sensor network, the 5-minute voltage data obtained from approximately 320,000 meters could allow SDG&E to support its operations, planning and regulatory activity needs. The phase identification capability could improve SDG&E's planning and operations abilities. When the two capabilities of the AMI system are combined, SDG&E could validate existing system models, verify voltage standard compliance, verify DER hosting capacity, determine PV impacts, determine PV impact mitigation solutions, assist in volt/reactive volt-ampere optimization and conservation voltage reduction activities. It will also be significantly less costly than a primary voltage solution.

Concern, Problem, or Gap to be Addressed: AMI is a rich source of data that could be of significant value in enhancing distribution system operating practices. Capabilities for accessing and applying the data to solving operating problems need to be demonstrated. This project will conduct pre-commercial demonstrations of alternative capabilities and identify preferred approaches. The project will culminate in recommendations for commercial adoption of the most successful methods and the identification of related the resource requirements.

[20] SDG&E has recently installed the first large VRF battery system of its type in the country and has existing lithium ion battery installations.

Applicable Electricity Value Chain Elements: Distribution.

Potential Benefits: This project is designed to help provide customer value by improved operating practices that contribute to better power quality, higher reliability, reduced electrical losses in the distribution system, increased safety, and reduced costs. The reduction of electrical losses also helps reduce greenhouse gas emissions by reducing the amount of power generation that would have been absorbed in system electrical losses.

4.6 Project 4: Safety Training Simulators with Augmented Visualization

Primary Area of IOU Framework: Grid Modernization and Optimization
Objective: The project will demonstrate and evaluate augmented reality applications for field focused design, operations, and asset monitoring and management solutions. It will demonstrate the ability of the latest simulator technologies to train utility industry personnel on safety related issues, such as electric potential zones and grounding techniques associated with construction work practices. Capabilities to be demonstrated will include the utilization of augmented reality tools to visualize and provide rich contextual information at the point of work.

Concern, Problem, or Gap to be Addressed: Safety training is important to every job, and its importance is elevated when dealing with high voltage power equipment used by utilities. Training simulators can provide valuable simulated experience to electrical workers. Analogous to flight simulators that teach pilots how to fly a plane safely (without actually flying it), advanced training simulators will help electric utility crews train for day-to-day operations in a safe manner. This project will demonstrate and evaluate advanced safety training simulators that focus on safety management of field operations, back-end support to field operations, and crew proficiency and productivity. These tools will provide applications to crews in the field, in utility vehicles, and in the backend operations center.

Technology or Strategy to be Demonstrated: The project will undertake pre-commercial demonstration of simulator technologies using augmented reality tools. Project activities may include, but not be limited to:

- Verifying that the simulators can be practically designed and applied for everyday training use;
- Conducting technical evaluation of simulator technology and feasibility for business integration;
- Determining capabilities and overall effectiveness of alternative solutions and making recommendations regarding adoption of specific solutions;
- Evaluating utility asset tracking and operational data and transferring to workers in the field using various mobile applications;

- Conducting pre-commercial demonstration of augmented reality application for utility network visualization and field workforce management; and
- Defining and recommending the requirements for adoption of these capabilities and technologies.

Applicable Electricity Value Chain Elements: Distribution (primary) and Transmission (secondary).

Potential Benefits: Employee safety is one of SDG&E's highest priorities. This project is designed to help improve worker safety at SDG&E (and at other utilities) by improving training simulator capabilities. These benefits may also help increase system reliability due to enhanced field workforce readiness with information about utility assets and situational awareness.

4.7 Project 5: Unmanned Aircraft Systems with Advanced Image Processing for Electric Utility Inspection and Operations

Primary Area of IOU Framework: Grid Modernization and Optimization
Objective: The project will demonstrate new applications of Unmanned Aircraft Systems ("UAS") with enhanced image processing capabilities for electric operations. The project will define, demonstrate and evaluate concepts for instrumentation and monitoring of the power system equipment using enhanced imaging on UAS and sensor technology. The project will evaluate the potential to increase reliability, safety and cost efficiency to improve power system operations.

Concern, Problem, or Gap to be Addressed: Technology advancements in monitoring, measurement and inspection can help reduce labor-intensive efforts to maintain and operate the power system infrastructure. Asset monitoring and inspection using UAS has emerged as a possible solution for remote asset inspections. SDG&E has done extensive work on UAS applications in prior years. Analysis and assessment of high quality images and data from the UAS have been shown to help SDG&E make time-sensitive decisions in day-to-day operations in many applications. This project seeks to demonstrate advanced monitoring and analysis capabilities that could expand the possible applications for UAS when identifying aging equipment and assets that need field work.

Technology or Strategy to be Demonstrated: The project will demonstrate practical applications of UAS that have strong implications for worker safety, system reliability, data collection and storage, and improved decision making in operations. The project will follow a simple process to capture, process, analyze, and share information using UAS. Examples of activities that may be included in the demonstration project are:

- Demonstrating and evaluating advanced imaging capabilities, such as Light Detection and Ranging ("LiDAR"), that can be used for asset monitoring, inspection and data collection;

- Demonstrating and evaluating multi-spectral sensors for high definition imagery, UV/reflectivity and infrared for detailed inspections;
- Utilizing UAS to identify various levels of corrosion on distribution equipment along coastal areas, and collect data into an SDG&E repository to perform data processing and analytics;
- Performing analysis to categorize corrosion levels to identify potential risks and associated operational plans;
- Demonstrating and evaluating capabilities of advanced-imaging-enabled UAS for disaster response; and
- Demonstrating and evaluating cost efficiencies in inspection performance for pilot operated flights versus autonomous UAS flights, where autonomous flight planning is used to assist the UAS pilot in command.

A final selection of project's demonstration focus, as well as the development of the project's specific scope and metrics, will be made in the project planning phase.

Applicable Electricity Value Chain Elements: Distribution (primary) and Transmission (secondary).

Potential Benefits: The combination of UAS monitoring and analysis with utility inspection capabilities is designed to improve service reliability, reduce costs, and increase employee and public safety. Specific benefit targets include early identification of failing assets, avoidance of catastrophic events, data for future predictive analytics, and improved engineering practices. Demonstrated uses of UAS in the utility space have the potential to benefit customers by avoiding more costly solutions.

4.8 Project 6: Repurposing Post Electric Vehicle Batteries for Utility, Commercial, and Mass Transit Applications

Primary Area of IOU Framework: Grid Modernization and Optimization
Objective: This project is intended to simplify future integration of used Electric Vehicle ("EV") batteries from multiple automakers (i.e., Original Equipment Manufacturer, also known as "OEMs"). This project will perform pre-commercial demonstration of repurposed, used EV batteries for the benefit of the utility system operations, commercial customers, and/or mass transit (such as electric trolleys or electric transit buses). This Post Electric Vehicle Energy Storage ("PEVES") project will identify solutions to minimize installation and integration costs by reusing OEM vehicle hardware, such as battery packs, power electronics, as well as software, such as communications and Open Vehicle Grid Integration Protocols ("OVGIP") for Controller Area Network ("CAN") buses.

Concern, Gap, or Problem to be Addressed: The PEVES market is nascent with learning needed to remove future growth barriers. This project will address reuse opportunities for used EV batteries, explore dispatch protocols for PEVES, and increase industry knowledge of secondary use energy storage. Sales of Battery Electric Vehicles

("BEV") and Plug-in Hybrid Electric Vehicles ("PHEV") show continued growth.[21] Used EV batteries have a remaining life potentially suitable for stationary uses. Identifying the longevity and remaining value of PEVES will influence reuse/recycle/disposal choices for used EV batteries.

Technology or Strategy to be Demonstrated: The PEVES project will demonstrate interconnected storage on the utility and/or customer side of the meter. The project will demonstrate reuse of OEM EV battery packs, electric hardware, software and communication pathways to the extent feasible and document the opportunities and challenges of reusing OEM technology for stationary uses. Dispatch control strategies via price signals using the EPRI OVGIP will be investigated. SDG&E's Integrated Test Facility will be used to identify and quantify performance metrics (e.g., number of battery cycles, capacity loss, and kWh throughput) and to test charge/discharge strategies. Load research data will be collected to compare circuit and/or customer peak load, voltage, and load factors before and after the PEVES installation.

Applicable Electricity Value Chain Elements: Distribution (primary) and Demand-Side Management (secondary).

Potential Benefits: This project is designed to find applications for repurposing EV batteries after they are no longer viable in their original vehicle applications. Successful repurposing may reduce the total cost of EV ownership if the owners can obtain residual value for the batteries by repurposing. Quantifying the PEVES value stream may also encourage more EV market growth if repurposing reduces the total cost of vehicle ownership and battery disposal. Repurposing may provide lower-cost stationary battery applications compared to new batteries.

4.9 Project 7: Demonstration of Multipurpose Mobile Battery for Port of San Diego and/or Other Applications

Primary Area of IOU Framework: Customer Focused Services

Objective: The objective of this project is to undertake a pre-commercial demonstration of a mobile battery system. The project will examine the possibilities for using a mobile battery at its home base (tentatively the Port of San Diego ("Port")) and at secondary energy hubs (such as SDG&E substations or large customers) within the service area. The project will evaluate stacking of various benefits that can be derived from one asset, the mobile battery, when rotated between its primary location and different energy hubs at multiple locations. The battery will be used at the Port cruise ship terminal during the peak cruise ship season and in other applications at other locations during non-peak season. The objective is to evaluate the effectiveness of mobile batteries when rotated between applications and identify preferred applications and strategy for the rotation.

[21] Inside EVs, Monthly Plug-in Sales Scorecard, available at http://insideevs.com/monthly-plug-in-sales-scorecard/ (last accessed April 27, 2017).

Concern, Problem, or Gap to be Addressed: While mobile batteries are commercially available, the utilization of the same asset at multiple locations and multiple use cases is new and needs to be demonstrated and evaluated. The Port's cruise ship terminal has an unusual load profile with high demand and low usage, resulting in a poor load factor. In addition, it is restricted geographically from pursuing certain solutions that it can employ to improve the load factor. This project seeks to demonstrate a new solution (i.e., mobile battery system) to assist the Port and other energy hubs in resolving these problems.

The demonstration will test the mobile battery for use in functions such as demand shaving, emergency energy supply, voltage regulation, and frequency regulation at the various energy hubs. The mobile battery allows for flexibility in a dynamically changing energy landscape.

Technology or Strategy to be Demonstrated: The project will evaluate the effectiveness, cost, and benefits of a mobile battery system in specific applications through a pre-commercial demonstration. The demonstration will be based on a multi-phased integration of a battery storage solution. The mobile battery will be deployed at the Port to see whether it can effectively provide auxiliary power at the cruise ship terminal to reduce the electricity needed by ships from shorepower.[22] For those ships that are not using shorepower, the mobile battery demonstration will assess whether it can be used to reduce the ships' need to run fuel-based generators and reducing carbon emissions. Additionally, the battery can be utilized at different locations depending on customer and utility needs. The storage asset will be mobile, so that it can be transported and deployed at more than one location depending upon need and the available capacity of the storage unit. Using a locational benefit model, SDG&E will deploy the asset to best demonstrate meeting the needs of the electric system, large customers, the community, and emergency infrastructure. The pre-commercial demonstration could still be undertaken at the other energy hubs if the Port is unable to participate. The use cases in the demonstration will test and evaluate the effectiveness of mobile batteries when rotated between major applications. A rotation and application strategy the results in optimum value will be sought. A recommendation regarding commercial adoption of the concept and strategy will be included in the final project report. SDG&E will own the mobile battery and have a disposition plan for it recommended in the final report.

Applicable Electricity Value Chain Elements: Distribution (primary) and Demand-Side Management (primary).

Potential Benefits: This project is designed to help support the State's objective of using efficient low-cost, low-emissions energy sources in the operations of its ports and

[22] Shore powers (a.k.a. cold-ironing) is the process of providing electrical power from the shore to a vessel at berth, thereby allowing the auxiliary engines to be turned off.

harbors, such as AB 628.[23] The project will create new knowledge on what stacked benefits can be achieved by rotating a portable battery to multiple strategic applications. This project will also help the Port reduce emissions of greenhouse gases and other pollutants and reduce periods of heavy localized electric power demand. It also supports the Port of San Diego's Climate Action Plan.[24]

5 Coordination and Consultation

5.1 Coordination among EPIC Administrators

SDG&E has fulfilled the requirements of D.12-05-037 to coordinate with the other EPIC Administrators through reasonable and constant collaboration throughout the plan development process. Starting in Spring 2012, SDG&E and the other EPIC Administrators instituted the tradition of frequent, often weekly, conference calls and the occasional working sessions. The practice of frequent coordination between the four EPIC Administrators has continued during the EPIC-3 Plan development. During these calls and working sessions, the EPIC Administrators coordinate their individual EPIC plans to prevent duplication, ensure consistent EPIC program implementation and administration, and determine if there are potential collaboration opportunities. These meetings have allowed for open discussions and an exchange of knowledge among the EPIC Administrators to ensure an effective common approach to EPIC-3.

5.2 Voluntary Consultation with Electric Power Research Institute

On January 30, 2017, SDG&E hosted a one-day workshop with the EPRI and the other EPIC Administrators. The purpose of the workshop was a gaps analysis on the proposed content of the EPIC plans to assure the projects were filling key gaps in the needed RD&D in a global context. Similar consultation with EPRI was also done for the EPIC-1 and EPIC-2 Plans.

5.3 Public Scoping Workshops with Stakeholders

On March 9 and 24, 2017, the IOU Administrators held joint public scoping workshops. At the workshops, the IOUs summarized their planning and coordination process and presented examples of projects under consideration for EPIC-3 cycle. As required by D.12-05-037,[25] SDG&E presented an overview of its draft EPIC-3 Plan to stakeholders at the workshops. SDG&E outlined its draft EPIC-3 Plan with its seven projects and described in detail three of the projects. The slides were also posted on SDG&E's

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[23] Assembly Bill 628 (Statutes of 2013, Ch. 741) encourages IOUs to engage in joint projects with California port and harbor districts to offer energy related alternatives and programs.

[24] "Port of San Diego Climate Action Plan, 2013", *available at* https://www.portofsandiego.org/climate-mitigation-and-adaptation-plan/documents/documents-1/5515-port-of-san-diego-climate-action-plan/file.html.

[25] D.12-05-037 at 31.

website for public review.[26] Stakeholders were encouraged to submit comments during and after the workshop. Both CEC and Commission Staff participated in the workshops.

5.4 Stakeholder Feedback and SDG&E's Response[27]

SDG&E received few comments from workshop participants concerning its EPIC-3 Plan. There were no disagreements with the content of the proposed plan. A summary of the comments and questions is provided herein:[28]

- Project 1 (Integration of Battery and Photovoltaic Systems into Utility Operations): There were clarifying questions posed regarding SDG&E's proposed project on integration of PV/battery systems into utility system operations. The questions were answered at the workshop.

- Project 6 (Repurposing Post Electric Vehicle Batteries for Utility, Commercial, and Mass Transit Applications): Questions were raised by workshop participants about the willingness of the operator of the San Diego light rail system to collaborate with SDG&E on this project. One participant noted that SMUD had attempted a battery repurposing project involving a transit system in their area. He said that the project was different and may not have been completed, but suggested that SDG&E contact them anyway to factor their experience into the SDG&E EPIC project. SDG&E will do so. One participant submitted two written project ideas related to vehicle battery repurposing and integration of charging infrastructure for electric vehicles. SDG&E found the stakeholder feedback useful and clarified the project intent and details of the description for Project 6 in this Plan.

- Project 7 (Demonstration of Multipurpose Mobile Battery for Port of San Diego and/or Other Applications): Questions were raised by workshop participants about the willingness of the Port to collaborate with SDG&E on this project. The Port has initially indicated its willingness to collaborate with SDG&E on this project.

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[26] SDG&E, EPIC, http://sdge.com/regulatory-filing/3749/electric-program-investment-charge-epic.

[27] D.12-05-037 requires each EPIC plan to include a summary of stakeholder comments received during the development of its EPIC-3 Plan and the Administrator's response to the comments.

[28] SDG&E also received one e-mail after the workshops that strongly endorsed the SDG&E EPIC-3 portfolio.

If the Port is unable to collaborate, the project will be done by applying the mobile battery at other energy hubs.

- Alternative Project Suggestion: One of the stakeholders suggested a hydrogen-based generation project for the IOUs. SDG&E rejected this idea because the EPIC IOU Administrators are prohibited from using EPIC funds for generation projects.

6 Estimated Project Budget and Project Management for SDG&E's EPIC-3 Investment Plan

6.1 Estimated 2018-2020 EPIC Budget and Funding Allocation

SDG&E has allocated its project budget for the EPIC-3 cycle as shown in Table 1. Pursuant to previous EPIC decisions, SDG&E proposes to only fund pre-commercial TD&D projects, and overall EPIC program administrative expenses.

The total project-level funding allocation for SDG&E EPIC Plan is $8196k.[29] An additional allocation of $916k is available for required program-level administration activities.[,]

The estimated project budget in Table 1 is only an estimate. All projects fall in the TD&D category, and funds can be reallocated among approved projects in the same category without limitation.[30]

[29] The amounts shown in Table 1 are taken from Table 5, Appendix B, of D.15-04-020 and then escalated by 2.065% to account for inflation, based on a calculation made by the utilities on what the estimated inflation over the past three years has been.

[30] D.15-09-005 at COL1.

Table 1
Estimated Budget for SDG&E EPIC-3 TD&D Project Funding (2018-2020)[31]

Investment Area for IOU Framework	Project Name	3-Year Project Estimate (Thousands 2017 dollars)
Grid Modernization and Optimization	Application of Advanced Metering Infrastructure (AMI) Data to Advanced Utility System Operations	1,771
	Safety Training Simulators with Augmented Visualization	833
	Unmanned Aircraft Systems (UAS) with Advanced Image Processing for Electic Utility Inspection and Operations	729
	Repurposing Post-Electric-Vehicle Batteries for Utility, Commercial, and Mass Transit Applications	833
Customer Services and Enablement	Demonstration of Multiple-Purpose Mobile Battery for Port of San Diego and Other Applications	937
Renewables and DER Integration	Integation of Battery and Photovoltaic Systems into Utility Operations	2,051
	Energy Storage Performance Evaluation	1,042
	Total Project Budget for EPIC-3 Cycle	$8,196

6.2 Project Management and Procedures for Competitive Solicitation of Contractors

The seven proposed projects will be executed by SDG&E staff teamed with RD&D contractors. The contracted work will be done primarily through competitively bid research contracts. SDG&E will use pay-for-performance contracts in accordance with its long-standing and documented procurement policies and procedures, including affiliate compliance rules. A contractor's performance will be measured by completion of milestones outlined in the contract and adherence to schedule and budget.

SDG&E will follow the "Adopted IOU EPIC Administrator Contractor Solicitation Process and Evaluation Guidelines" as approved in D.13-11-025.[32] Whenever possible, SDG&E will use a competitive process, starting with a Request for Information ("RFI") or Request for Qualifications ("RFQ") to perform an initial screen, before issuing a Request for Proposal ("RFP"). The RFP will be sent to potential suppliers including certified (or certifiable) Diverse Business Enterprises ("DBE").

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[31] SDG&E recognizes that the EPIC collections, and thus the EPIC allocations, will be adjusted on January 1, 2018 in accordance with D.12-05-037. If the Commission-approved adjustment rate differs from the Administrators' estimate of 2.065%, SDG&E proposes that the budgetary adjustment, whether to increase or decrease the budget, will be proportionally distributed among the seven projects' estimated funding in Table 1.

[32] D.13-11-025 at Attachment 3.

Bids will be scored against predetermined evaluation criteria. Successful bidders must demonstrate that they have expertise in the areas of the work specified in the RFP for the specific project. They must also demonstrate the ability to design the needed experimental systems, take the data, perform the analyses, and draw critical conclusions from the analyses to support attainment of the project objective.

As required by previous EPIC decisions, SDG&E's EPIC annual reports will include the number of bidders passing the initial pass/fail screening test and the ordinal rank of the selected bidder. If the selected bidder did not have the highest score, an explanation will be provided.[33] The identity, scope of work and deliverables of the winning bidders will be included in SDG&E's EPIC annual reports. If there are active contract negotiations at the time of filing the EPIC annual report, the information on the winning bidders will be disclosed within 90 days of executing the contract.[34]

There may be situations where competitive bidding is not possible or not justifiable due to cost issues. For example, a project may require unique expertise or the equipment that can only be obtained from one provider, or the cost of competitive bidding would exceed the cost of the services or materials. In these instances, SDG&E may decide to use its "sole source" procurement procedures. Any non-competitive awards will be documented and justified in SDG&E's EPIC annual report.[35]

There will be no limitations on funding, such as per-project, per-awardee, or matching funding requirements. Cost sharing will be sought, but will not be required.

6.3 SDG&E's Approach to EPIC-Funded Intellectual Property

SDG&E will employ Intellectual Property ("IP") methodologies that are consistent with the requirements for EPIC-funded IP outlined by the Commission.[36]

6.4 Project Metrics

Detailed project-specific metrics will be developed during the project planning phase of the projects (i.e., the first phase). SDG&E will use both quantitative metrics and qualitative criteria to evaluate results coming from the demonstrations. SDG&E will use the metrics jointly developed by the IOU Administrators and approved by the Commission, as applicable.[37]

The primary purpose of RD&D is to create, document, and transfer new knowledge. Project results will be delivered in the form of reports, spreadsheets, or other

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[33] D.13-11-025 at OP 17.

[34] D.13-11-025 at OP 25.

[35] D.13-11-025 at OP 18.

[36] D.13-11-025 at 68-89.

[37] D.13-11-025 at Attachment 4.

appropriate deliverables prepared by SDG&E and contractor project staff. Any such project results will be provided with the next annual EPIC report following that project's completion. The primary such deliverable for each project will be a comprehensive final report documenting the project results in a form that could be used by the stakeholders.

7 Potential Benefits of the SDG&E-3 Plan

The seven projects selected for the SDG&E EPIC-3 Plan are designed to help improve safety, advance power system infrastructure and improve system operations for the customers' benefit. By helping to improve safety, enhance capabilities for utility interoperability of renewable resources and energy storage, use AMI data to improve system operations, improve capabilities and broaden the scope of applications for SDG&E's existing UAS capabilities, obtain solutions for electric vehicle battery repurposing, and optimize use of mobile battery systems, the projects proposed in the SDG&E EPIC-3 Plan have the potential to help provide the following customer benefits:

1. Improved Safety: Workforce safety is a very high priority for SDG&E. Project 4 will demonstrate employee training simulators with augmented visualization capabilities. Project 5 will demonstrate new unmanned aircraft applications with advanced image processing for images taken by cameras on the UAS. This work will enable SDG&E to further increase its use of UAS in inspections and maintenance activities. Collectively, these projects have the potential to increase the overall safety for both customers and utility workers and the power system reliability, if subsequently commercially adopted by SDG&E.

2. Improved Reliability and Power Quality: Two goals of power system modernization are to improve the level of reliability and to optimize the quality of power as seen by the customer. Higher reliability means reducing the occurrences of outage and reducing the duration of outages when they do occur. Improved power quality means reducing the disturbances seen in the power itself, such as voltage variation, flicker, and harmonic content in the power waveform.

3. Improved Performance of the Power System: Improved system operations and performance (i.e., system electrical efficiency) will help reduce electrical losses in the system, such as reductions in resistive losses associated with current flow through the conductors and reductions in transformer electrical losses. Projects 1, 2 and 7 on integration of renewables and storage and Project 3 on strategic use of AMI to improve voltage regulation all contribute to directly to reduced electrical losses. The other three projects contribute indirectly to reduced energy losses.

4. Lower Greenhouse Gas Emissions: Advanced infrastructure will help reduce system electrical losses, which in turn will help reduce the need for electric generation. Less generation means fewer greenhouse gas emissions. Projects 1, 2, 3, and 7 have a direct connection to this benefit;

the other three projects have an indirect connection. Also, the successful solutions that are demonstrated for integrating more renewables into utility operations (Projects 1 and 2) will contribute to greenhouse gas reductions, by offsetting the need for generation from fossil fuels.

5. Lower Operating Costs and More Efficient Use of Customer Monies: If they are successful, the EPIC-3 projects can help contribute to lower operating costs. The most significant potential in this regard comes from Projects 1, 2, 3, and 4.

6. Economic Development: A secure source of low-cost, high-quality, reliable electric power is essential to economic development and to retain and attract businesses in California.

SDG&E's proposed EPIC-3 portfolio is designed to realize the above benefits. The relative potential for each benefit varies by project. Table 2 summarizes the expected benefit areas for all seven projects.

Table 2: Benefits Summary for EPIC-3 Projects

Investment Area for IOU Framework	Project Name	Safety	Reliability	Improved Performance of Power System	Lower Greenhouse Gas Emissions	Lower Operating Costs	Efficient Use of Ratepayer Funds	Economic Development
Grid Modernization and Optimization	Application of Advanced Metering Infrastructure (AMI) Data to Advanced Utility System Operations	✓	✓	✓	✓	✓	✓	✓
	Safety Training Simulators with Augmented Visualization	✓	✓	✓	✓	✓	✓	✓
	Unmanned Aircraft Systems (UAS) with Advanced Image Processing for Electic Utility Inspection and Operations	✓	✓	✓	✓	✓	✓	✓
	Repurposing Post-Electric-Vehicle Batteries for Utility, Commercial, and Mass Transit Applications	✓	✓	✓	✓	✓	✓	✓
Customer Services and Enablement	Demonstration of Multiple-Purpose Mobile Battery for Port of San Diego and Other Applications	✓	✓	✓	✓	✓	✓	✓
Renewables and DER Integration	Integation of Battery and Photovoltaic Systems into Utility Operations	✓	✓	✓	✓	✓	✓	✓
	Energy Storage Performance Evaluation	✓	✓	✓	✓	✓	✓	✓

8 SDG&E's Proposed EPIC-3 Projects are Consistent with Sections 740.1 and 8360

Public Utilities Code Section 740.1 requires that the Commission consider specific guidelines when evaluating the research, development and demonstration projects proposed by electrical and gas corporations.[38] SDG&E's EPIC-3 Program meets these requirements.

In accordance with Section 740.1, proposed projects should offer a reasonable probability of providing benefits to customers. SDG&E's EPIC-3 projects have the potential to provide electric utility customers benefits, including greater reliability, lower costs, and increased safety, as well as various other complementary benefits.

Section 740.1 states that expenditures on projects with a low probability for success should be minimized. SDG&E has selected seven projects for pre-commercial demonstration of various system integration solutions. The knowledge gained from these demonstrations will aid in resolving key problems now facing system operations. The integration solutions are to be built up from existing components, standards, and

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[38] P.U. Code Section 740.1 states:

> The commission shall consider the following guidelines in evaluating the research, development, and demonstration programs proposed by electrical and gas corporations:
>
> (a) Projects should offer a reasonable probability of providing benefits to ratepayers.
>
> (b) Expenditures on projects which have a low probability for success should be minimized.
>
> (c) Projects should be consistent with the corporation's resource plan.
>
> (d) Projects should not unnecessarily duplicate research currently, previously, or imminently undertaken by other electrical or gas corporations or research organizations.
>
> (e) Each project should also support one or more of the following objectives:
>
> (1) Environmental improvement.
>
> (2) Public and employee safety.
>
> (3) Conservation by efficient resource use or by reducing or shifting system load.
>
> (4) Development of new resources and processes, particularly renewable resources and processes which further supply technologies.
>
> (5) Improve operating efficiency and reliability or otherwise reduce operating costs.

software, wherever possible. Therefore, the probability of success in the selected SDG&E EPIC-3 projects is reasonable.

Section 740.1 requires that projects remain consistent with the corporation's resource plan. Again, this requirement is fulfilled by the SDG&E EPIC-3 Plan because its projects were selected after a rigorous internal process that ensured the plans aligned with SDG&E's infrastructure needs and corporate objectives.

Section 740.1 also requires SDG&E to avoid unnecessarily duplicating research being done by another entity. SDG&E has worked to ensure that, to the best of its knowledge, its EPIC-3 projects are not duplicative of other known TD&D plans by completing a gaps analysis with EPRI, researching other known TD&D efforts, and soliciting feedback on its plans from stakeholders and the other EPIC Administrators.

EPIC expenditures must follow the statutory guidance provided by Section 8360 of the California Public Utilities Code. Section 8360 states that it is the policy of the State to modernize the state's electrical transmission and distribution system to maintain safe, reliable, efficient, and secure electrical service, with infrastructure that can meet future growth in demand and achieve ten separate objectives.[39]

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[39] P.U. Code Section 8360 states:

> It is the policy of the state to modernize the state's electrical transmission and distribution system to maintain safe, reliable, efficient, and secure electrical service, with infrastructure that can meet future growth in demand and achieve all the following, which together characterize a smart grid:
> (a) Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.
>
> (b) Dynamic optimization of grid operations and resources, including appropriate consideration for asset management and utilization of related grid operations and resources, with cost-effective full cyber security.
>
> (c) Deployment and integration of cost-effective distributed resources and generation, including renewable resources.
>
> (d) Development and incorporation of cost-effective demand response, demand-side resources, and energy-efficient resources.
>
> (e) Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices for metering, communications concerning grid operations and status, and distribution automation.
>
> (f) Integration of cost-effective smart appliances and consumer devices.
>
> (g) Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air-conditioning.

The SDG&E EPIC-3 Plan meets this power system-centric statutory standard with ample sufficiency because the entire Plan and its project components are designed to demonstrate new infrastructure and operating solutions for the benefit of customers and improved safety.

9 Summary of SDG&E's Approved EE and DR Projects

D.12-05-037 and D.13-11-025 require IOU Administrators to include information about ongoing Efficiency ("EE") and Demand Response ("DR") projects in their EPIC Plans to avoid duplication between the EE/DR projects and the EPIC projects. Specifically, each IOU Administrator must "include an appendix summarizing the R&D activities undertaken as part of their approved Energy Efficiency and Demand Response portfolios. This appendix should describe each project, including the purpose, funding, deliverables and progress to date."[40] SDG&E has provided the required information in Appendices A (SDG&E's Approved Energy Efficiency (EE) Portfolio) and B (SDG&E's Approved Demand Response (DR) Portfolio).

None of SDG&E's ongoing EE and DR projects are duplicative of SDG&E's EPIC-3 projects. This is not surprising since SDG&E's ongoing EE and DR projects are traditional *post-commercialization* demonstrations, so none of them would even qualify EPIC projects.

SDG&E's activities that fall under Energy Efficiency are part of SDG&E's Emerging Technologies Energy Efficiency ("ET-EE") subprogram.[41] The mission of the Emerging Technologies subprogram is to support increased energy efficiency market demand and technology supply by contributing to the development and deployment of new and underutilized energy efficiency technologies, practices, and tools, and by facilitating their adoption as measures supporting California's aggressive energy and demand savings goals.[42]

SDG&E's ongoing ET-EE projects are summarized in Appendix A. None of them overlap with SDG&E's EPIC-3 projects.

(h) Provide consumers with timely information and control options.

(i) Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid.

(j) Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

[40] D.13-11-025 at 66.

[41] SDG&E's 2015 ET-EE program was approved by the Commission in D.14-10-046.

[42] SDG&E 2015 EE Portfolio including its EE-Emerging Technology program was approved in D.14-10-046, Figure 7, at pp. 107-108.

SDG&E's ongoing Emerging Technology Demand Response ("ET-DR") efforts consist of evaluating demand-reducing technologies and strategies that are applicable to the San Diego region and market.[43] The ET-DR program's focus is on technologies and strategies that promise significant, cost-effective demand reduction in the short- or mid-term, and that appear to be sufficiently reliable and scalable for market-wide implementation. The ET-DR program is intended to identify, evaluate and demonstrate technologies that have strong potential to reduce power consumption during periods of higher energy prices or tight energy supplies in all SDG&E customer segments (i.e., residential, agricultural, commercial and industrial), and to help bring these technologies to commercial availability.[44]

SDG&E's ongoing ET-DR projects are summarized in Appendix B. None of them overlap with SDG&E's EPIC-3 projects.

10 Conclusion

SDG&E's EPIC-3 Plan contains seven projects that have been carefully vetted with internal and external stakeholders. The development of the Plan has been coordinated with the other EPIC administrators and reviewed with EPRI in a formal gap analysis workshop. This Plan also provides various mappings to policy and value chain issues.

The projects proposed in the Plan are timely in terms of priorities of the Commission, SDG&E, electric customers, and the energy industry and are designed to help create customer value by achieving improvements in safety, distribution system infrastructure and operating practices. The planned EPIC-3 projects were screened to avoid duplication with SDG&E's EE and DR activities. The Plan's budget estimate makes efficient and effective use of the EPIC-3 funds that SDG&E is responsible for administering. For these reasons, SDG&E respectfully requests that the Commission approve SDG&E's EPIC-3 Plan in its entirety.

[43] SDG&E's 2015 ET-EE program was approved by the Commission in D.14-10-046.

[44] SDG&E's 2017 DRP Portfolio including its DR-Emerging Technology programs was approved in D.16-06-029.

Appendix A: SDG&E's Approved Energy Efficiency (EE) Portfolio

Program	Project Description	Purpose	Funding	Deliverables	Current Update/Comment
ET-EE	Low Cost CA Solar Initiative	Demonstration showcase to demonstrate "deep" energy savings of over 50% and a new "plug & play" solar photovoltaic system in a residential home and to provide a local green job training opportunity.	160,000	Final Report to be published to etcc-ca.com	Sent data to Rob Hammond for analysis in spring 2016 awaiting report
ET-EE	EPRI NILM Assessment	This is a supplemental EPRI project to assess non-intrusive load management technologies for their effectiveness at identifying individual loads.	45,000	Final Report published by EPRI	Final reporting complete
ET-EE	Phase Change Materials Evaluation	Phase change materials are becoming more popular in building designs, with the material being installed in wall cavities as well as in drop-ceiling applications. The product claims to allow peak shifting and energy savings by allowing cooling of the thermal mass during the evenings and allowing the building to coast through peak times with the thermal mass. This study intends to look at two applications and try to evaluate the effectiveness of building energy models at simulating the benefits of phase change materials.	85,000	Final Report to be published to etcc-ca.com	Data collection is nearly complete, building the models in eQuest
ET-EE	Distributed High Efficiency Packaged Refrigeration With Low Ammonia Charge and Electronic Refrigerant Injection Control	The technology promises to be more efficient than incumbent technologies. Part of the efficiencies of the technology come from eliminating the central engine room and long piping runs, eliminating the need for large ammonia charges, and minimizing the parasitic loads associated with traditional design for ammonia refrigerants in refrigerated warehouses. The technology is fully automated, can be remotely monitored and dramatically reduces risk. Its control system can report energy usage, be optimized for peak energy reductions, and is demand response ready.	90,000	Final Report to be published to etcc-ca.com	On hold
ET-EE	Dynamic Air Balancing for Commercial HVAC systems	Testing the technology at 3 sites. The technology promises potential energy efficiency savings in commercial buildings through air flow balancing, predictive weather analytics, better occupancy detection, enthalpy economizers, demand control ventilation, and multistage thermostat controls. There is also potential for demand response.	147,554	Final Report to be published to etcc-ca.com	Working on site selection
ET-EE	HVAC Heat Rejection into Hotel Pool	Evaluating a recommended design practice for commercial pools where a co-located HVAC system will reject heat to the pool water, offsetting therms for pool heating.	120,000	Final Report to be published to etcc-ca.com	Finalizing FDAs, cost of custom HVAC equipment and scheduling site installs
ET-EE	HVAC Retrofit Controls for Compressor cycling optimization	Two technologies that take advantage of refrigerant characteristics and compressor cycling to optimize energy usage while still providing the necessary cooling to the space. This retrofit item sits in between the thermostat and RTU, and adds additional temperature sensors in the return air and supply air ducts to optimize the compressor cycling. The study will compare the performance of these two units and attempt to characterize the increase in equipment cycling to determine if a reduction in useful life results from the technology.	85,000	Final Report to be published to etcc-ca.com	Finalizing sites
ET-EE	Color Tunable LED	Evaluation of the efficacy, efficiency and operational nature of LED's which offer color adjustability.	48,500	Final report published by EPRI	Final products being tested in the labs
ET-EE	Alternative Refrigerants for Enhancing Customer Value	Understand the changing nature of refrigerant options in HVAC/R, as refrigerants move toward low global warming potential (GWP) compounds.	100,000	Final report published by EPRI	Project initiating with EPRI
ET-EE	EPRI Data Center Collaborative	Examine techniques for identifying small and medium-sized data centers in a utility's service territory and the energy savings potential of these facilities. Assess the energy use, performance, cost, and market barriers of various technical solutions for data centers. Conduct field demonstration at a local data center. Develop new approaches for utilities to increase end user/customer engagement	75,000	Final report published by EPRI	Project initiating with EPRI
ET-EE	Absorption Chiller Demonstration	Absorption chiller installed on campus to leverage waste heat from a co-located fuel cell. This combination of systems provides energy and free cooling to facilities by utilizing what would otherwise have been waste from the fuel cell. Depending on the regulations surrounding ZNE, this could be a good opportunity for larger facilities to reach ZNE.	24,000	Final Report to be published to etcc-ca.com	Site visit complete, baseline data collected, collecting retrofit data
ET-EE	SDUSD ZNE Direct Design Assistance	An elementary school is one of the 2 schools chosen for the Prop 39 grant. The purpose of this M&V study is to provide an energy model and plan of action to improve the energy performance and cost-effectiveness of the school to meet the code and ultimately reach ZNE.	22,000	Final Report to be published to etcc-ca.com	
ET-EE	Middle School, ZNE Retrofit Case Study	A middle school is one of the 2 schools chosen for the Prop 39 grant. The purpose of this M&V study is to provide an energy model and plan of action to improve the energy performance and cost-effectiveness of the school to meet the code and ultimately reach ZNE.	63,000	Final Report to be published to etcc-ca.com	
ET-EE	Smart Home Implementation	A vendor has developed an integrated smart home offering initially targeted towards new multifamily implementations. As part of this study SDG&E is exploring the potential of their technology for implementation as a single family home retrofit solution. The test will involve a look at energy savings and demand response potential from the technology and if successful will move into a second phase for further evaluation.	55,000	Final Report to be published to etcc-ca.com	Completed installations, gathering data to confirm products validity
ET-EE	Soil Moisture Sensor Evaluation	SDG&E is working with the San Diego Farm Bureau to offer soil moisture sensing technology that will assist farmers with shifting their irrigation pump usage to off-peak hours as they have been transitioned to TOU rates. The ET group is going to study whether these soil moisture sensors also enable energy savings through more efficient watering by trying to validate BPA's worksheet for energy savings as a result of soil moisture sensors.	65,000	Final Report to be published to etcc-ca.com	Installing M&V equipment at Pt Loma farms, exploring 2 additional farms as of 6/20
ET-EE	MicroBrewery Energy Savings Opportunities	With over 100 microbreweries in San Diego, ET is going to explore what opportunities exist to develop energy savings best practices for breweries and what new technologies could provide therms, kWh, and water savings at smaller scale breweries.	TBD	Final Report to be published to etcc-ca.com	Data for intial review provided to consultant

Appendix B: SDG&E's Approved Demand Response (DR) Portfolio

Program	Project Description	Purpose	Funding	Deliverables	Current Update/Comment
ET-DR	Fast Demand Response Technologies and Demonstration at SDG&E Energy Innovation Center using OpenADR	Demonstrated a fast DR system architecture for DR resources participation in ancillary services using the OpenADR 2.0b	16,000	Final report posted on the etcc-ca.com in 2016	None
ET-DR	Flywheel Energy Storage (Amber Kinetics)	40 kWh / 10 kW Flywheel Energy Storage	150,000	Final report to be posted on the etcc-ca.com	Report being finalized
ET-DR	Open Vechical to Grid Intergration Platform	This project will create requirements and use cases for a unified grid services platform that is secure, low cost, and ope to a variety of vendors. A main objective is to develop the architecture and functionality of the platform and assess performance of the platform against utility requirements though field tests and and trials.	100,000	Final report to be posted on the etcc-ca.com	Project Ongoing
ET-DR	Smart Thermostat Collaborative	The project will pool learnings from the different utilities running thermostat pilots as well as provide a framework for M&V methodologies with smart thermostats. Some of the secondary research questions being addressed deal with the technology architectures for providing utility demand response, the customer implications of program design between direct install and bring your thermostat, and a better understand of customer interaction and value provided by these devices.	70,000	Final report to be posted on the etcc-ca.com	Lessons Learned Info Provided from research
ET-DR	Whole Home Connected DR	This project would allow the connection of various devices (pool pump, water heater, washer, dryer, dishwasher, thermostat, etc...) to be connected all to one platform and evaluate the load reduction capabilities. This project would also entail overall system design between products of different manufacturers. At least two of the most attractive design hierarchies would be selected and implemented for this project.	150,000	Final report to be posted on the etcc-ca.com	3 Homes Selected. Planning for installs.
ET-DR	Battery Power Load Shedding System – ADR Evaluation	To evaluate the demand response capability of the energy storage system. In addition to peak load shaving capability, the impact of the energy storage system on the circuit and the customer bill/economics will be studied.	271,728	Final report to be posted on the etcc-ca.com	In Phase 2 of 2 for installing batteries and M&V equipment at each site
ET-DR	EPIC DR Lighting for Non-Residential Building Stock	To evaluate California Energy Code's DR control system requirements' costs and benefits across California's existing, non-residential building stock. Determine and estimate energy savings achieved with baseline lighting retrofits; and energy benefits and costs to the building owners to provide automated DR capability.	22,679	Final report to be posted on the etcc-ca.com	Review draft report

Appendix C: Glossary of Acronyms and Abbreviations

Acronym/Abbreviation	
AMI	Advanced Metering Infrastructure
BEV	Battery Electric Vehicles
CAISO	California Independent System Operator
CAN bus	Controller Area Network bus
CEC	California Energy Commission
Commission	California Public Utilities Commission
D.	Decision
DBE	Diverse Business Enterprises
DER	Distributed Energy Resources
DMS	Distribution Management System
DR	Demand Response
EE	Energy Efficiency
EPIC	Electric Program Investment Charge
EPIC Administrators	SDG&E, PG&E, SCE, and CEC
EPIC IOU Administrators	Investor-Owned Utilities, Specifically PG&E, SDG&E, SCE
EPRI	Electric Power Research Institute
ESS	Energy Storage Systems
ET-DR	Emerging Technology Demand Response Program
ET-EE	Emerging Technologies Energy Efficiency
EV	Electric Vehicles
GHG	Greenhouse Gas
IEC	International Electrotechnical Commission
IOU	Investor-Owned Utility
IP	Intellectual Property
LiDAR	Light Detection and Ranging
OEM	Original Equipment Manufacturer
OVGIP	Open Vehicle Grid Integration Protocol
PEVES	Post Electric Vehicle Energy Storage
PG&E	Pacific Gas and Electric Company
PHEV	Plug-in Hybrid Electric Vehicles (PHEV)
Prosumer	Producers and Consumers
PV	Photovoltaic
R&D	Research and Development

Acronym/Abbreviation	
RD&D	Research, Development, and Demonstration
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Qualifications
RMA	Renewable Meter Adapter
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric Company
SDG&E EPIC-3 Plan	SDG&E Third Triennial EPIC Investment Plan
UAS	Unmanned Aircraft Systems
VAr	Volt-Ampere Reactive
VRF	Vanadium Redox Flow
Working Framework	IOU Working EPIC Framework
ZNE	Zero Net Energy