PACIFIC GAS AND ELECTRIC COMPANY

ELECTRIC PROGRAM INVESTMENT CHARGE (EPIC)
2019 ANNUAL REPORT

FEBRUARY 28, 2020

ATTACHMENT A:
2019 EPIC Annual Report

ATTACHMENT B:
2019 EPIC Annual Report Appendix A

ATTACHMENT C:
2019 EPIC Annual Report Appendix B

PACIFIC GAS AND ELECTRIC COMPANY

ATTACHMENT A

2019 EPIC ANNUAL REPORT

Pursuant to Decision (D.) 12-05-037 – Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge (EPIC) and Establishing Funding Collections for 2013-2020, Pacific Gas and Electric Company (PG&E) hereby files the 2018 Annual Report for the EPIC Program.

In compliance with Ordering Paragraph (OP) 16, a copy will also be served on all parties in the most recent EPIC proceedings; the most recent General Rate Cases (GRC) of PG&E, Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E); and each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year.

<u>Service Lists</u>:

EPIC 2012-2014: Application (A.) 12-11-001, A.12-11-002, A.12-11-003, and A.12-11-004.

EPIC 2015-2017: A.14-05-003, A.14-05-004, A.14-05-005, and A.14-04-034.

EPIC 2018-2020: A.17-04-028, A.17-05-003, A.17-05-005, and A.17-05-009.

EPIC Research Administration Plan: A.19-04-026

EPIC Program Renewal OIR: R.19-10-005

PG&E recently filed GRC: A.18-12-009.

SCE recently filed GRC: A.19-08-013.

SDG&E RECENTLY filed GRC: A.17-10-007.

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PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE (EPIC)
2019 ANNUAL REPORT

1. Executive Summary

A. Overview of Program and Plan Highlights

Pursuant to the California Public Utilities Commission (CPUC or Commission) D.12-05-037, Pacific Gas and Electric Company (PG&E or the Company), and the other Administrators of the Electric Program Investment Charge (EPIC) Program were directed to file annual reports each year beginning February 28, 2013 through February 28, 2020 with the Director of the CPUC's Energy Division.[1] Annual Reports shall be served on all parties in the most recent EPIC proceeding, all parties to the most recent GRC of each electric utility, and to each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year. In compliance with Ordering Paragraph 16 of D.12-05-037, and consistent with the Annual Report outline developed collaboratively by the EPIC Administrators and the Public Advocates Office at the California Public Utilities Commission,[2] PG&E files its eighth annual report.

In D.12-05-037, the Commission authorized funding in the areas of applied Research and Development (R&D), Technology Demonstration and Deployment (TD&D), and Market Facilitation. The Investor-Owned Utility (IOU) Administrators' role was limited to TD&D only.

On November 19, 2013, the CPUC issued D.13-11-025, which authorized the first triennial investment period of 2012-2014 (referred to as EPIC 1). On April 15, 2015, the CPUC issued D.15-04-020, which approved the second triennial investment plan period of 2015-2017 (referred to as EPIC 2). On August 10, 2017, the CPUC issued Resolution (Res.) E-4863, which approved two of the six new EPIC projects proposed by PG&E via a Tier 3 Advice Letter 5015-E filed on February 7, 2017, between triennial EPIC

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1 The four EPIC Program Administrators are PG&E, SCE, SDG&E, and the California Energy Commission (CEC).

2 This annual report outline is based on the adopted EPIC Administrator Annual Report Outline as described in Attachment 5 of D.13-11-025.

Applications as permitted by D.15-09-005. On April 28, 2017, PG&E filed its A.17-04-028 for the third triennial investment plan period of 2018-2020 (referred to as EPIC 3). On October 25, 2018, the CPUC issued D.18-10-052, which approved the third triennial investment plan period of 2018-2020 but directed utility administrators not to spend, commit or encumber one-third of their respective EPIC program budgets until the commission approves their joint Research Administration Plan (RAP) application. On April 23, 2019, the utilities filed their joint RAP application, and on February 10, 2020, the Commission issued D.20-02-003 approving the RAP application and authorizing the utilities to encumber, commit, and spend the remaining one-third of their EPIC 3 budgets.

This report summarizes PG&E's projects' progress and status for the approved funding cycles, which includes TD&D projects in the following areas:

1) **Renewables and Distributed Energy Resource (DER) Integration** – Integrate DERs, generation and storage; improve transparency of resource information; increase generation flexibility.

2) **Grid Modernization and Optimization** – Optimize existing grid assets; prepare for emerging technologies; design and demonstrate grid operations of the future.

3) **Customer Service and Enablement** – Drive customer service excellence through new offerings for PG&E's customers that enable greater customer choice; integrate Demand-Side Management (DSM) for grid optimization.

4) **Cross Cutting/Foundational Strategies and Technologies** – Enhance and apply tools to better prepare and respond to natural disasters (e.g., risk analytics, wildfire ignition, and impact efforts), support next generation infrastructure, including smart grid architecture, cybersecurity, telecommunications and standards, as well as other "foundational" activities in support of all three program areas above.

PG&E continues to be strongly committed to the EPIC Program and the value it provides to its customers, as it offers the opportunity to cost-effectively develop and demonstrate innovative technologies which can advance the Company's core values of Safety, Reliability, Resiliency, and Affordability. Through these projects, the EPIC Program also contributes learnings that support important and ambitious California policy priorities, such as Greenhouse Gas (GHG) reduction goals, distributed energy resources, renewable energy targets, and wildfire risk and impact mitigation.

With the climate-induced challenges of increasing wildfires and extreme weather events, increased grid visibility, flexibility and advanced data-driven technology operations are key. Through its EPIC 3 project portfolio, PG&E is actively exploring technologies that can mitigate ignition risk and associated potential impact on public safety. These technologies hold significant promise to advance PG&E's wildfire risk mitigation, bolster operational capabilities, increase the flexibility of the grid, and allow for greater system resiliency.

PG&E's 2019 TD&D Program Highlights

PG&E launched four EPIC 3 projects and completed an EPIC 1 project between the publishing of the 2018 and 2019 annual reports, which brings the total number of completed projects to date to 34. Currently there are two EPIC 2 projects, and five EPIC 3 projects in flight.

For detailed information on the developments and status of each EPIC 1, EPIC 2, and EPIC 3 project, see Appendix A.

EPIC 1

In the first triennial cycle, the EPIC 1 portfolio demonstrated PG&E's ability to adopt a new model for managing, aligning, tracking and executing research, development and demonstration (RD&D) activities. This portfolio covered a wide spectrum of technologies that help make the electric grid safer, more reliable, and more affordable for customers, and to advance clean energy policy objectives. Most of the EPIC 1 projects closed out in 2017 and examples of their achievements are detailed in prior annual reports.

The final EPIC 1 project, *EPIC 1.22 – Demonstrate Subtractive Billing with Submetering for EVs to Increase Customer Billing Flexibility* closed out in 2019. Through this project, PG&E identified key elements of third-party EV submetering solutions that will need to be improved before they are deployed to serve the state of California. PG&E identified that for third-party solutions to meet revenue-grade metering standards, improvements will need to be made in metering accuracy, data transfer reliability, and communication network reliability. The project's purpose, methods, findings, results, and industry-relevant learnings are further documented in the final report attached in Appendix B.

<u>EPIC 2</u>

The projects from EPIC 2 are even more focused on long-term strategic objectives and in many cases are built on the foundations developed through previous EPIC projects. Most of the EPIC 2 projects closed out in 2018 and 2019, and examples of their achievements are detailed in prior annual reports. The last two EPIC 2 projects will close in 2020:

EPIC 2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors is demonstrating the use of RF sensor technology that could allow PG&E to more effectively identify and locate degrading assets and risks of failure in the distribution system, to enable proactive maintenance and further safety and resiliency. Field demonstration of RF-based sensors is underway on live distribution circuits. The technology employs the use of pole-mounted RF-based sensors for incipient fault detection by monitoring partial discharge events, which may be caused by broken insulators, mechanical damage, or vegetation contact. In parallel, an alternative technology, which uses advanced algorithms to analyze voltage and current waveform data for proactive fault anticipation, is also being demonstrated to compare the performance and effectiveness of RF-based technologies.

EPIC 2.36 - Customer Rate Design Tool is demonstrating that through a software platform, PG&E can more systematically and efficiently explore new experimental rate designs, including those that could yield more equitable, cost-based rate structures that minimize cross-subsidies within revenue classes. This tool enables complex rate design exploration for DER adoption, provides a faster and more robust approach to rate design and leverages big data technology to evaluate hypothetical new rate structures based on full information with nuanced sensitivity analysis. This project is in its closeout phase.

<u>EPIC 3</u>

In 2019 PG&E launched four EPIC 3 projects with an increased focus on safety and resiliency. Projects focus on wildfire risk reduction and Public Safety Power Shutoff (PSPS) impact reduction. Five other projects are in the planning phase with expected launch by mid-2020.

EPIC 3.03 - Advanced Distributed Energy Resource Management Systems (DERM) and Advanced Distribution Management System (ADMS) is developing a DERMS head-end system and associated interfaces for DER telemetry & control and demonstrating this system on: (1) an operational remote grid and (2) non-grid DERs participating in a Non-Wire Alternative (NWA) project. If successful, this project could inform operating strategies and produce capabilities to significantly increase the flexibility of the grid and provide fundamental capabilities to reduce overall wildfire risk exposure and increase resilience for customers. The project could also reduce the cost of telemetry associated with large scale DERs interconnected to PG&E's grid.

EPIC 3.11 – Location Targeted DERs is configuring the Arcata-Eureka airport's local microgrid controller to integrate with PG&E's distribution network and enable Distribution Control Center visibility and control of the microgrid. The project is developing scalable and replicable approaches to planning, designing, deploying and operating multi-customer microgrids. The results of this project could inform operating strategies and produce capabilities to significantly increase the flexibility of the grid and provide fundamental capabilities to advance system resiliency.

EPIC 3.15 – Proactive Wire Down Mitigation is demonstrating Rapid Earth Fault Current Limiter (REFCL) technology at a PG&E substation serving a high fire-risk area, to assess its effectiveness at automatic current reduction in wires-down events, with the goal of drastically reducing the likelihood of wires down events causing wildfires.

EPIC 3.20 – Data Analytics for Predictive Maintenance is leveraging Geographic Information System (GIS), weather, SmartMeter™, Supervisory Control and Data Acquisition (SCADA) and other data to develop and demonstrate analytical models that predict when maintenance will be needed for distribution assets. If successful, this project could significantly improve PG&E's ability to proactively predict imminent asset failure. This will result in reducing the number of asset failures, which will reduce public safety risk and the risk of wildfire ignition.

EPIC 3.43 – Momentary Outage Analytics is developing analytical models that use Advanced Metering Infrastructure (AMI) momentary events and trap alarms to identify issues with customer service drops, insulator failures, and intermittent vegetation contact. The data model developed through this project, which analyzes SmartMeter™ data with higher granularity, could proactively predict imminent distribution equipment failures before they occur. This capability may result in more immediate or tactical recommendations for actions to mitigate distribution system risks, thereby reducing public safety risk.

Potential Benefits

Upon closeout of EPIC 3 projects, PG&E will report forward-looking estimates of potential benefits if the technology is deployed in production. PG&E will also report the quantification of any benefits realized during the demonstration. PG&E will continue to provide updates on realized benefits for key projects after they have closed through its subsequent EPIC Annual Reports. This information will support the establishment of the joint EPIC database directed in D.8-10-052. EPIC 3 projects are expected to start closing in 2021.

EPIC Intellectual Property

In 2019, PG&E was granted patents with the United States Patent and Trademark Office and international protection through the Patent Cooperation Treaty for the following EPIC projects:

- EPIC 1.21 – Pilot Methods for Automatic Identification of DERs (such as Solar Photovoltaics (PV)) as They Interconnect to the Grid to Improve Safety & Reliability: Patent for an algorithm which can detect unauthorized PV interconnections.
- EPIC 2.29 – Mobile Meter Applications (NextGen Meter – NGM): Patent on mobile meter with modular housing/board assembly

Before 2019, PG&E filed for non-provisional patent protection for the following EPIC projects:

- *EPIC 1.14 – Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities*: Patent for the development of the Smart Pole Meter, Smart Pole Meter Socket, Patent for an algorithm to help identify downed wires.
- *EPIC 2.26 – Customer and Distribution Automation Open Architecture Devices:* Patent for algorithms to communicate and control edge devices through the Advanced Metering Infrastructure (AMI) network.

An additional provisional patent was also filed for the following EPIC project:

- *EPIC 2.22 – Demand Reduction Through Targeted Data Analytics:* Provisional patent for system and server for parallel processing mixed integer programs for load management.

These patents may provide potential future revenue generating opportunities that would be shared with PG&E's customers and shareholders,[3] and ultimately support improved affordability if the patents lead to increased revenue. PG&E continues to consider opportunities to license patents, as well as opportunities to identify additional Intellectual Property in these and other projects.

Further Technology Advancement Needs

It is important to recognize the value of EPIC in determining that a technology is not ready to scale and identifying necessary improvements that can help bring technologies to market. For example, through EPIC 1.22 – Demonstrate Subtractive Billing with Submetering for EVs to Increase Customer Billing Flexibility Project, PG&E identified that for third-party solutions to meet revenue-grade metering standards, improvements will need to be made in metering accuracy, data transfer reliability, and communication network reliability.

EPIC also helps to identify where technology advancement is necessary before it is considered for adoption on a larger scale, which ultimately supports affordability for customers by ensuring the solution has high potential to transition from the demonstration stage to deployment stage. One such effort is being pursued in EPIC 2.34 Predictive Risk Identification with RF Added to Line Sensors. Through the ongoing demonstration of pre-commercial RF-based sensors to detect incipient faults on distribution circuits, the project team has been acquiring valuable lessons learned through field testing at a demonstration scale. The team has provided prescriptive feedback to

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3 The revenue sharing mechanism is based on the guidance provided in CPUC D.13-110-25 OP 34, which states:

> [IOUs] must apply a 75 percent/25 percent (ratepayer/shareholder) revenue sharing mechanism for net revenues (from future or ongoing royalties, license fees, and other "financial benefits of IP") related to financial benefits of IP that was developed under IOU contracts with Electric Program Investment Charge funds.

vendors, such as ideas on product miniaturization and design improvements to enable more efficient installation and maintenance, all of which will help advance the technology to a more mature level for eventual deployment at a larger scale.

Status of Programs

In D.13-11-025, the CPUC approved 27of the 29 projects proposed by PG&E in the EPIC 1 Investment Plan, since two projects were formally withdrawn by PG&E prior to the issuance of this decision.[4] In D.15-04-020, the Commission approved the 31 projects proposed by PG&E in the EPIC 2 Plan.[5] In Res.E-4863, the Commission approved two of the six projects proposed by PG&E in the Tier 3 AL 5015-E filed between triennial EPIC Applications.[6] On April 28, 2017, PG&E filed A.17-04-028 for the third triennial investment plan period of 2018-2020 (referred to as EPIC 3) which included 43 proposed projects. On October 25, 2018 in D.18-10-052, the Commission approved the 43 projects in PG&E's proposed EPIC 3 Investment Plan with minor modifications. The Commission also required the utilities to file a joint application containing a RAP, identifying program administration improvements in response to the 2017 EPIC program evaluation within 180 days and required utilities not to commit, encumber or spend one-third of their EPIC 3 budgets until a subsequent decision that approved RAP. On April 23, 2019, the utilities filed their joint RAP application, and on February 10, 2020, the Commission issued D.20-02-003 approving the RAP application and authorizing the utilities to encumber, commit, and spend the remaining one-third of their EPIC 3 budgets.

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4 In the EPIC 1 Plan (A.12-11-003), PG&E originally proposed 26 projects. Project 1.09 was subsequently split into three projects and project 1.10 was split into two projects, resulting in a total of 29 projects. The projects formally withdrawn by PG&E were projects 1.04 and 1.07.

5 In the EPIC 2 Plan (A.14-05-003), PG&E originally proposed 30 projects. Per CPUC D.15-04-020 to include an assessment of the use and impact of EV energy flow capabilities, Project 2.3 was split into two projects, resulting in a total of 31 projects.

6 In the Tier 3 Advice Letter 5015-E filed between triennial EPIC applications, PG&E originally proposed six projects. CPUC Res.E-4863 approved two (Projects 2.34 and 2.36) of the six proposed projects, allowed PG&E's withdrawal of one project (Project 2.31), deferred two projects to a future investment plan (Projects 2.32 and 2.33) and rejected one project (Projects 2.35).

EPIC Administrators continue to participate in regular review meetings, conduct joint webinars and workshops, and regularly collaborate on EPIC-related matters. The EPIC Administrators generally meet bi-weekly to discuss EPIC and their respective objectives for the program, as well as to ensure collaboration and avoid duplication.

PG&E has an internal governance structure that ensures approved projects within the TD&D Program adhere to the EPIC guiding principles and requirements, as well as the potentially changing marketplace and evolving technologies to ensure PG&E maximizes this program to continue to meet customer needs while maintaining safety, reliability, resiliency, and affordability of the grid. With the Commission's issuance of D.20-02-003 approving the RAP application and authorizing the utilities to encumber, commit, and spend the remaining one-third of their EPIC 3 budgets, PG&E will define, prioritize, select and launch a second wave of EPIC 3 projects. Prior to selection and launch of this wave of projects, PG&E will facilitate a public workshop with EPIC stakeholders to gather and incorporate input on the proposed projects.

The following table summarizes the projects' funding status by area and triennial investment plan program cycle as of December 31, 2019.

TABLE1: SUMMARY OF PROJECT STATUS AND FUNDING BY PROGRAM CYCLE

EPIC Program Areas	EPIC 1	EPIC 2	EPIC 3	Total
Renewables / DER Resource Integration	**Projects: 3** • 1.01 Energy Storage End Uses • 1.02 Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction • 1.05 Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output ***Committed Funding: $6.0M - $7.3M**	**Projects: 5** • 2.02 Pilot DERMSs • 2.03A Test SI Enhanced Capabilities – PV • 2.03B Test SI Enhanced Capabilities – Vehicle to Home • 2.04 DG monitoring & Voltage Tracking • 2.05 Inertia Response Emulation for DG impact improvement **Committed Funding: $13.7M - $15.6M**	**Projects: 2** • 3.03 DERMS and ADMS Advanced Functionality • 3.11 Location-Specific Options for Reliability and/or Resilience Upgrades **Committed Funding: $5.5M – 6.8M**	**Projects: 13** **Committed Funding: $25.2M - $29.7**
Grid Modernization & Optimization	**Projects: 7** • 1.08 Improve Distribution System Safety & Reliability through New Data Analytics Techniques • 1.09A Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching • 1.09B/1.10B - Test New Remote Monitoring & Control System for T&D Assets / Demonstrate New Strategies and Tech to Improve the Efficacy of Existing Maintenance and Replacement Programs • 1.09C Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors • 1.14 Demonstrate “Next Generation” SmartMeter™ Telecom Network Function • 1.15 Demonstrate New Technologies and Strategies That Support Integrated “Customer-to-Market-to-Grid” Operations of the Future • 1.16 Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages **Committed Funding: $16.1M - $19.7M**	**Projects: 5** • 2.07 Real Time Loading Data for Distribution Operations & Planning • 2.10 Emergency Preparedness Modeling • 2.14 Automatically Map Phasing Information • 2.15 Synchrophasor Applications for Generator Dynamic Model Validation • 2.34 Predictive Risk Identification with RF Added to Line Sensors **Committed Funding: $10.4M- $11.8M**	**Projects: 5** • 3.13 Transformer Monitoring via Field Area Network (FAN) • 3.15 Proactive Wires Down Mitigation • 3.20 Data Analytics for Predictive Maintenance • 3.21 Advanced Vegetation Management Insights using Prescriptive Analytics • 3.43 Service Issue Identification Leveraging Momentary Outage Information **Committed Funding: $13.6M - $16.5M**	**Projects: 17** **Committed Funding: $40.1M - $48.0M**

TABLE1: SUMMARY OF PROJECT STATUS AND FUNDING BY PROGRAM CYCLE (CONTINUED)

EPIC Program Areas	EPIC 1	EPIC 2	EPIC 3	Total
Customer Service & Enablement	**Projects: 7** • 1.18 Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information • 1.19 Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform • 1.21 Pilot Methods for Automatic Identification of DERs (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability • 1.22 Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility • 1.23 Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility • 1.24 Demonstrate DSM for T&D Cost Reduction • 1.25 Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid **Committed Funding: $8.7M - $10.6M**	**Projects: 5** • 2.19 Enable Distributed Demand-Side Strategies & Technologies • 2.21 Home Area Network (HAN) for Commercial Customers • 2.22 Demand Reduction through Targeted Data Analytics • 2.23 Integrate Demand Side Approaches into Utility Planning • 2.36 Dynamic Rate Design Tool **Committed Funding: $9.3M-$10.5M**	**Projects: 2** • 3.27 Multi-Purpose Meter (MPM) • 3.32 System Harmonics for Power Quality Investigations **Committed Funding: $4.3M - $5.3M**	**Projects: 14** **Committed Funding: $22.3M - $26.4M**
Cross-Cutting/ Foundational	**Projects: 0** **Committed Funding: $0M**	**Projects: 4** • 2.26 Customer & Distribution Automation Open Architecture Devices • 2.27 Next Generation Integrated Smart Grid Network Mgmt. • 2.28 Smart Grid Communications Path Monitoring • 2.29 Mobile Meter Applications **Committed Funding: $6.9M-$7.8M**	**Projects: 1** • 3.41 Drone Enablement and Operational Use **Committed Funding: $2.1M - $2.5M**	**Projects: 5** **Committed Funding: $9.0M - $10.3M**
Summary	**Total Funded Projects: 17** **Total Committed Funding: $30.8M-$37.7M** **Total Project Funding Encumbered: $22.0M** **Total Project Funding Spent to Date: $34.6M** **Total Administrative Costs Spent to Date: $3.0M**	**Total Funded Projects: 19** **Total Committed Funding: $40.2M-$45.7M** **Total Project Funding Encumbered: $24.7M** **Total Project Funding Spent to Date: $43.3M** **Total Administrative Costs Spent to Date: $4.4M**	**Total Funded Projects: 10** **Total Committed Funding: $25.6M – $31.0M** **Total Project Funding Encumbered: 3.4M** **Total Project Funding Spent to Date: $3.9M** **Total Administrative Costs Spend to Date: $0.5Mk**	**Total Funded Projects: 46** **Total Committed Funding: $96.6 - $114.4M** **Total Project Funding Encumbered: $50.1M** **Total Project Funding Spent to Date: 81.8M** **Total Administrative Costs Spent to Date: $7.5M**

Projects are prioritized through an internal governance process in order to manage committed funding. Remaining funds may, as needed, be redirected to other approved projects in order to efficiently utilize customer funds.

2. Introduction and Overview

A. Background on EPIC

The EPIC Program is designed to assist the development of pre-commercialized, new, and emerging energy technologies in California, while providing assistance to commercially viable projects. Through EPIC, PG&E develops and demonstrates innovative technologies that advance a broad array of objectives including grid safety, resiliency and reliability as well as customer enablement, and integration of renewable and DERs.

EPIC demonstration projects aid in identifying key requirements and insights to inform full deployment in a manner that strategically aligns the integration of technologies with existing operations. Given the rapidly evolving energy landscape and the impact of climate change in California, the continuation of technology innovation programs like EPIC is critical to the continued advancements of grid capabilities to enable advancements on safety and resiliency.

Funding for EPIC is authorized in Public Utilities Code (Pub. Util. Code) Section 399.8, which governed the Public Goods Charge (PGC) until expiration on January 1, 2012. The Commission opened an Order Instituting Rulemaking (OIR) (Rulemaking) (R.11-10-003) to establish the Electric Program Investment Charge to preserve funding for the public ratepayer benefits associated with the renewables and RD&D activities provided by the electric PGC. The rulemaking included two phases, with Phase 1 to establish the EPIC Program on an interim basis in 2012, and Phase 2 to establish purposes and governance for EPIC to continue from 2013-2020.[7] The EPIC Program Administrators include the CEC and three Electric IOUs: PG&E, SCE, and SDG&E.

In its Phase I Decision Establishing Interim Research, Development and Demonstrations and Renewables Program Funding Levels (D.11-12-035), the CPUC established 2012 funding at approximately $142 million, and authorized PG&E, SCE, and SDG&E to institute the EPIC Program, effective January 1, 2012, to collect funds for renewables programs, and RD&D programs at the same level authorized in 2011. Additionally, the surcharge was imposed on all

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7 See Phase 1 D.11-12-035 and Phase 2 D.12-05-037.

distribution customers based on the existing rate allocation between customer classifications, and collected in the Public Purpose Program component of rates.

On May 24, 2012, the Commission issued its Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge and Establishing Funding Collections for 2013-2020. The decision established an annual funding amount of $162 million for the 2012-2014 EPIC Program cycle (EPIC 1) and set the funding allocations among the three IOUs as 50.1 percent, 41.1 percent and 8.8 percent for PG&E, SCE, and SDG&E, respectively.[8] On April 15, 2015, the CPUC issued D.15-04-020, which approved the second triennial investment plan period of 2015-2017 (EPIC 2). On October 25, 2018 in D.18-10-052, the Commission approved the third triennial investment plan period of 2018-2020 (EPIC 3) and ordered the utilities to jointly develop and file a RAP application that identified improvements the utilities would make in response to the recommendations made in the independent EPIC program evaluation. On April 23, 2019, the utilities filed their joint RAP application, and on February 10, 2020, the Commission issued D.20-02-003 approving the RAP application and authorizing the utilities to encumber, commit, and spend the remaining one-third of their EPIC 3 budgets.

B. EPIC Program Components

Authorized by D.12-05-037, the EPIC Program is to fund investments in the following three areas: (1) Applied R&D; (2) TD&D; and (3) Market Facilitation which consists of market research, regulatory permitting and streamlining, and workforce development activities. PG&E and the other IOU administrators were designated to administer EPIC funds only in the area of TD&D. The CEC was designated to administer funds in all areas, including a portion of TD&D.

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8 OP 7 of D.12-05-037 requires the total collection amount to be adjusted on January 1, 2015 and January 1, 2018 commensurate with the average change in the Consumer Price Index for Urban Wage Earners and Clerical Workers for the third quarter, for the previous three years.

C. EPIC Program Regulatory Process

D.12-05-037 defines the regulatory process and governance for the EPIC Program. The decision requires EPIC Program Administrators to submit Triennial Investment Plans to cover 3-year cycles for 2012-2014, 2015-2017, and 2018-2020. The investment plans must include details about planned investments, as well as criteria for selecting and evaluating proposals. Each plan must be evaluated and approved by the Commission prior to program implementation. To date, Administrators have filed three Triennial Investment Plans for 2012-2014, 2015-2017 and 2018-2020. On October 25, 2018 in D.18-10-052, the Commission approved the EPIC 3 Investment Plan. In addition to the Triennial Investment Plans, the Administrators are required to file Annual Reports each year on February 28 through 2020, as well as Final Reports for each project.

D. Coordination

In order to ensure adequate coordination of the EPIC Program, the EPIC Administrators continue to participate in regular review meetings, conduct joint webinars and workshops, and regularly collaborate on EPIC-related matters. The EPIC Administrators generally meet bi-weekly to discuss EPIC and their respective objectives for the program, as well as to ensure collaboration and avoid duplication.

The IOU Administrators also continue to work together to leverage consistent approaches, where feasible, for meeting the objectives of the EPIC Program. This collaboration resulted in the development of a common EPIC framework, approved by the Commission in D.13-11-025, to help guide the individual IOU investment plans.

The CPUC established the Policy + Innovation Coordination Group (PICG) in D.18-01-008 and D.18-10-052. The PICG will identify opportunities for policy and innovation coordination, provide expertise, knowledge and analysis, and support coordination and feedback between administrators and the CPUC. Per D.18-10-052, PG&E is responsible for administering the contract with PICG Project Coordinator and acting as the fiscal manager on behalf of the CPUC. On December 27th, 2019 PG&E executed this contract. PG&E looks forward to continuing to coordinate with the EPIC Administrators and CPUC through this framework.

E. Transparent and Public Process

The Program's Administrators hold stakeholder workshops during the planning and implementation of the EPIC Triennial Investment Plans to ensure stakeholder feedback is received and incorporated. These stakeholder workshops to prepare for the Third Triennial Investment Plan were executed at the beginning of 2017 in advance of the EPIC 3 Application. Additionally, Administrators continue to engage with industry stakeholders by participating in and presenting at conferences, as well as hosting workshops/symposiums annually.

During the planning of the RAP application, which was submitted to CPUC on April 23, the Utilities engaged extensively with the CEC, peer R&D groups, disadvantaged community (DAC) groups and other interested stakeholders through a total of 13 stakeholder engagement sessions, to help define improvements to the utilities' program administrative practices.

In 2019, the EPIC Administrators conducted the EPIC Symposium on February 19 in Sacramento, California, and the EPIC Fall Workshop on November 8 in San Diego, California.

In the EPIC Symposium, PG&E presented EPIC 2.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility and also jointly facilitated with the Utilities a preliminary RAP workshop with EPIC stakeholders.

In the EPIC Fall Workshop the objectives were to inform stakeholders on changes to the EPIC program such as the new PICG, provide the status overview of launched and upcoming EPIC 3 projects, and facilitate discussion on the RAP and future stakeholder engagement plans. Public notice for these events is provided to a broad range of stakeholders including technology vendors, DAC, diverse suppliers, researchers, academics and energy consultants. The utilities and the CEC will continue to maintain transparency in the process via webinars and workshops.

Now that the Commission issued D.20-02-003 approving the RAP application and authorizing the utilities to encumber, commit, and spend the remaining one-third of their EPIC 3 budgets, PG&E will plan to launch a second wave of EPIC 3 projects. Prior to the selection and launch of projects, PG&E will facilitate a public workshop with EPIC stakeholders to gather input on the proposed projects that will inform the details of their scoping.

Furthermore, PG&E's EPIC Program continues to remain accessible to the interested public. PG&E's EPIC website (www.pge.com/epic) includes EPIC Program information and updates, as well as EPIC annual reports and projects' final reports.

3. Budget

A. Authorized Budget

The following table outlines the total Program, Administrative, and CPUC regulatory oversight budget for each triennial cycle.

TABLE 2: TOTAL AUTHORIZED BUDGET BY PROGRAM CYCLE

Total Authorized Budgets	**PG&E Program Budget** *(TD&D only)*	**PG&E Admin. Budget** *(TD&D only)*	**CEC Program Budget*** *(TD&D, Applied R&D, & Market Facilitation)*	**CEC Admin Budget*** *(TD&D, Applied R&D, & Market Facilitation)*	**CPUC Regulatory Oversight Budget**
EPIC 1: 2012-2014	$43.3 Million	$4.9 Million	$166.2 Million	$18.5 Million	$1.2 Million
EPIC 2: 2015-2017	$45.7 Million	$5.1 Million	$182.9 Million	$20.4 Million	$1.3 Million
EPIC 3: 2018-2020	$49.7Million	$5.5 Million	$199.1 Million	$22.2 Million	$1.4 Million

**portion remitted by PG&E*

B. Commitments[9]/Encumbrances[10]

The following table outlines the PG&E total financial commitments and encumbrances, as well the remittances made to both the CEC and CPUC beginning from program inception through December 31, 2019.

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9 Per CPUC D.13-11-025, "committed funds" are monies budgeted for a particular project. The committed fund range is defined as the project is approved through PG&E's internal governance process.

10 Per CPUC D.13-11-025, "encumbered funds" refer to monies specified within contracts signed during a previous triennial investment plan cycle and associated with specific activities under that contract.

TABLE 3: TOTAL COMMITMENTS/ENCUMBRANCES BY PROGRAM CYCLE

Commitments/ Encumbrances	PG&E Total Commitments*	PG&E Total Encumbrances**	CEC Program Remittance	CEC Admin Remittance	CPUC Remittance
EPIC 1: 2012-2014	$30.8 - $37.7 Million	$22.5 Million	$166.2 Million	$18.5 Million	$1.2 Million
EPIC 2: 2015-2017	$40.2 - $45.7 Million	$24.7 Million	$171.9 Million	$20.4 Million	$1.3 Million
EPIC 3: 2018-2020	$25.6 – 31.0 Million	$3.5 Million	$17.1 Million	$16.2 Million	$0.9 Million

**PG&E Total Commitments do not include PG&E Admin costs.*
***Some encumbered funds amounts have been retroactively updated to reflect some previous duplication in systems.*

C. Dollars Spent on In-House Activities

The following table outlines the PG&E total in-house project expenditures and administrative costs, beginning from program inception through December 31, 2019.

TABLE 4: TOTAL DOLLARS SPENT ON IN-HOUSE ACTIVITIES BY PROGRAM CYCLE

Program Cycle	PG&E In-House TD&D Project Expenditures *	PG&E In-House Program Administrative Costs
EPIC 1: 2012-2014	$11.5 Million	$1.8 Million
EPIC 2: 2015-2017	$19.6 Million	$3.4 Million
EPIC 3: 2018-2020	$2.7 Million	$0.5 Million

**PG&E In-House TD&D Project Expenditure includes internal staffing and staff augmentation at the project level. Some "Funds Expended to date: Contract/Grant Amount ($)" and "Funds Expended to date: In house expenditures ($)" have been updated. PG&E transitioned to a new cost model in 2016 that included changes to the structure of the allocation of overheads resulting in a change to how certain costs settled.*

D. Fund Shifting Above 5 Percent between Program Areas

All PG&E projects are within TD&D; therefore, there has been no fund shifting between program areas.

E. Uncommitted/Unencumbered Funds[11]

Projects without committed funding are pending further project and benefits analysis. The range of uncommitted funds is dependent on the range of authorized budget and committed funds as identified in Sections 3a and 3b, respectively. The following table outlines the PG&E

11 "Uncommitted" and "Unencumbered" funds refer to monies that are not identified in solicitation plans or obligated to a particular project—these funds are considered unspent.

uncommitted/unencumbered funding for each program cycle as of December 31, 2019.

TABLE 5: TOTAL UNCOMMITTED/UNENCUMBERED FUNDS BY PROGRAM CYCLE

Program Cycle	Uncommitted/Unencumbered Project Funds
EPIC 1: 2012-2014	$5.5 – $9.1 Million
EPIC 2: 2015-2017	$0 – $2.4 Million
EPIC 3: 2018-2020	$18.7 – 24.1 Million

F. Directly Awarded Funds

As filed in the RAP[12], PG&E will provide justification for all directly-awarded contracts and provide project and summary level information in the annual report. Overarching company policy is to fill out a Direct Award Request Form, as included in Appendix B of RAP, for proposed direct award of $250,000 or greater. This amount will be $75,000 for EPIC projects starting 2020. Justifications for direct awards are provided in Appendix A. The following table summarizes the PG&E directly awarded contracts executed in 2019 at the onset of EPIC 3. PG&E is in the process of competitively bidding a number of additional contracts that will be reflected in the 2020 report.

TABLE 6: TOTAL DIRECTLY AWARDED FUNDS BY PROGRAM CYCLE

Program Cycle	PG&E Total Vendor Contract Amount	PG&E Directly-Awarded Vendor Contract Amount	Directly-Awarded Contract Proportion
EPIC 3: 2018-2020	$3.3 Million	$3.3 Million	100%

12 Joint Application Of Southern California Edison Company (U 338-E), Pacific Gas And Electric Company (U 39-E), And San Diego Gas & Electric Company (U 902-E) For Approval Of The Research Administration Plan For The Electric Program Investment Charge https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/EPIC-3-Application-Joint.pdf

G. Match Funding

As filed in RAP[13], PG&E will start reporting match funding to date beginning with its EPIC 3 projects. PG&E's EPIC 3 projects launched to-date have not received match funding.

4. Projects

A. Summary of Project Funding

For a summary of project funding please refer to Table 1 in Section 1b.

B. Project Status Report (See Appendix A)

See Project Status Report, Appendix A, with project details as of December 31, 2019. The Project Status Report is based on the format provided in Attachment 6 of D.13-11-025.

C. Project Descriptions and Updates

The project descriptions and updates included below are for EPIC 1, EPIC 2, and EPIC 3 projects. Projects that are on hold have been included in the summary.

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13 *Ibid.*

Project #1.01 – Energy Storage End Uses

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Grid Operation/Market Design

iii. Objective

- Develop technologies and strategies for efficient and optimized bidding and scheduling of Energy Storage Technologies (EST) in California Independent System Operator (CAISO) markets and demonstrate those strategies using PG&E's existing Sodium Sulfur Battery Energy Storage Systems (NaS BESS).
- This project addresses the following CPUC proceedings:
  - As applicable, operational experiences gained from this project can inform outstanding policy and implementation issues as identified in Energy Storage OIR, R.15-03-011.

iv. Scope

- Develop and deploy technology to enable automated resource response to CAISO market awards.
- Quantify the values that battery resources can capture in CAISO markets.
- Establish financial performance of battery resource participation in CAISO markets.

v. Deliverables

- Demonstrate automated and remote-control application for generic energy storage resources to interface with existing SCADA systems.
- Report financial performance from participation in CAISO markets.
- Report comparison of actual performance vs. hypothetical performance quoted in industry reports.
- Comply with regulatory requirements and establish framework/recommendations for accounting standards applicable to energy storage.

vi. Metrics

- 1i – Nameplate capacity (megawatts) of grid-connected energy storage.
- 3a – Maintain/Reduce operations and maintenance costs.
- 6a – CAISO NGR financial settlements.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360).

- 7c – 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 (Pub. Util. Code § 8360).
- 7l – Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services (Pub. Util. Code § 8360).
- 9c – EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: CPUC R.10-12-007).

vii. Schedule

- 2.75 years

viii. EPIC Funds Encumbered

- $ $698,506

ix. EPIC Funds Spent

- $1,833,968

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.02 – Demonstrate the Use of Distributed Energy Storage for Transmission and Distribution (T&D) Cost Reduction

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Distribution; Grid Operation/Market Design

iii. Objective

- Demonstrate the ability of a utility operated energy storage asset to address capacity overloads on the distribution system and improve reliability.
- This project addresses the following CPUC proceedings:
  - This project will count towards the IOU energy procurement targets as set forth in D.10-03-040, the Energy Storage Procurement Framework.
  - As applicable, operational experiences gained from this project can inform outstanding policy and implementation issues as identified in Energy Storage OIR R.15-03-011.

iv. Scope

- Deploy utility operated energy storage asset at a single site.
- Demonstrate peak shaving use case along with other site-specific use cases as suggested by distribution operators (DO).

v. Deliverables

- Identify energy storage site based on project objectives.
- Identify an economic modeling tool to compare the planned traditional utility with alternatives using distributed resources or demand-side investments.
- Construct and integrate energy storage system.
- Test system and analyze results to prove project objectives.

vi. Metrics

- 1c – Avoided procurement and generation costs.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360).
- 7d – Deployment and integration of cost-effective distributed resources and generation, including renewable resources (Pub. Util. Code § 8360).
- 9c – EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: Deferring a capacity upgrade has been identified as a key potential value of EST and noted in filings with the CPUC/Assembly Bill (AB) 2514.

vii. Schedule

- 3.5 years

viii. EPIC Funds Encumbered

- $ $2,691,736

ix. EPIC Funds Spent

- $4,010,510

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- No

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in February 2018.
- Final Report included in 2017 EPIC Annual Report.

Project #1.03 – Demonstrate Priority Scenarios from the Energy Storage Framework

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Grid Operation/Market Design

iii. Objective
   - The project aims to reduce existing barriers to deployment of battery energy storage systems by demonstrating whether post-electric vehicle (EV) "second life" batteries can cost-effectively perform electric distribution services. The project will demonstrate the potential for reduced energy storage system costs via a) the development of an integration platform for deploying such batteries (Phase 1) and b) the use of lower cost "second life" batteries in the integrated platform (Phase 2).

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update

- Project not executed.

Project #1.04 – Expand Test Lab and Pilot Facilities for New Energy Storage Systems

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Grid operations/market design

iii. Objective
   - This project would identify ways to enhance the existing test lab facilities at PG&E's Applied Technology Services (ATS) center to provide lab test and pilot facilities for new energy storage systems not previously lab tested. PG&E's ATS lab will be particularly helpful in working with the CEC and industry to test "next generation" technologies that have the potential to make breakthroughs in cost, performance targets, and other important parameters, in a test grid environment. This testing would be a critical step in accelerating commercialization of potential "game changing" technology. New types of technology that may be tested at ATS include, but are not limited to, advanced lithium devices, new sodium-based systems, zinc-air systems and new flow battery chemistries and formats. The funding required to add full capabilities to ATS is minimal. The costs to perform the tests will be paid by the industry or by entities that have received research grants from agencies such as the CEC or Department of Energy (DOE).

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - N/A

ix. EPIC Funds Spent
   - N/A

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.

Project #1.05 – Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution

iii. Objective
- Demonstration of emerging capabilities in mesoscale modeling to provide more granular and accurate weather forecasting input to PG&E’s storm damage prediction model, and to other PG&E forecasting applications, like catastrophic wildfire risk and PV generation. The main goal is more effective and granular damage prediction, and therefore more efficient response to storm events.

iv. Scope
- Project focus is on development, deployment, and implementation of an operational version of the Weather Research and Forecasting (WRF) mesoscale model to support PG&E’s forecasting program related to fire, storms and solar production.
- Not in scope for this project are enhancements to PG&E’s RWP, other than improved forecast damage numbers.

v. Deliverables
- Fully functional mesoscale modeling system known as POMMS (PG&E Operational Mesoscale Modeling System) that will provide the following:
  - Detailed weather input into PG&E’s damage prediction modeling system (SOPP).
  - Next generation wildfire threat awareness system.
  - Historical and forecast solar irradiance data to internal PG&E stakeholders.

vi. Metrics
- 3a – Maintain/Reduce operations and maintenance costs.
- 4a – GHG emissions reductions (MMTCO2e).
- 5c – Forecast accuracy improvement.
- 5e – Utility worker safety improvement and hazard exposure reduction.

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $535,055

ix. EPIC Funds Spent

- $823,890

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.06 – Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Grid Operation/Market Design

iii. Objective
- This project would demonstrate the use of accepted communications protocols to allow the CAISO to send an operating signal to reduce output under specified conditions, as allowed by contracts.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- N/A

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update

Project not executed.

Project #1.07 – Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Grid operations/market design

iii. Objective
   - There are 33 General Electric (GE) 7FA gas turbines installed in combined cycle configurations in California, which is considerably more than any other turbine model. GE offers a product marketed as “OpFlex Balance” that uses advanced controls technology to improve ramp rates to as high as 40 megawatts (MW) per minute (or higher in some cases). As of October 2012, none of the 7FAs in California were using this product. This project proposes to demonstrate improved ramp rate capabilities on one 7FA so that it can serve as a model for the rest of the 7FA fleet. It is assumed that there would be cost share with the vendor and the selected plant owner.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - N/A

ix. EPIC Funds Spent
   - N/A

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Formally Withdrawn CPUC A.12-11-003, 10/15/2013.

Project #1.08 – Improve Distribution System Safety and Reliability Through New Data Analytics Techniques

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Transmission; Distribution

iii. Objective

- Develop and demonstrate a new data analytics technique to improve distribution system safety and reliability. The project specifically developed and tested a System Tool for Asset Risk (STAR), which is an enterprise software application that Electric Operations will use to calculate and display (graphically and geospatially) risk scores for electric transmission, substation and distribution assets. The STAR will enable an automated, system-wide application to improve risk identification, prioritization, and investment decisions to support electric system safety.

iv. Scope

- Demonstrate whether the ever-increasing amounts of data can be mined and combined for targeted, cost-effective use for improved asset management.
- Potential scenarios include risk-based asset management, safety hazard mitigation and proactive outage prediction using self-serve and virtual integration environments.

v. Deliverables

- Overview of existing applications and data sources.
- Assessment of existing data source quality.
- High-level future business processes by functional area.
- Inventory of asset risk algorithms (formulas or complexity) for “In Scope” asset classes.
- High-level Change Management Approach.
- Prioritized and phased implementation plan.
- Cost estimate for full implementation of the STAR project.
- Proof of concept prototype.

vi. Metrics

- 7c – Dynamic optimization of grid operations and resources; including appropriate consideration for asset management and utilization of related grid operations and resource, with cost-effective full cyber security (Pub. Util. Code § 8360).

- 3a – Maintain/Reduce operations and maintenance costs: With the improved understanding of risk, there could be a better tool for evaluating projects such as asset replacement.

vii. Schedule

- 2.25 years

viii. EPIC Funds Encumbered

- $1,249,505

ix. EPIC Funds Spent

- $2,112,640

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2015.
- Final report included in 2015 EPIC Annual Report.

Project #1.09A – Test New Remote Monitoring and Control Systems for Existing Transmission and Distribution Assets: Close Proximity Switching

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - This project explores and seeks to discover effective, new tools to safely operate “Solid Blade in Oil Rotatory Switches.”

iv. Scope
   - Test new tools and techniques for safe operation of Solid Blade in Oil Rotatory Switches.
   - Evaluate alternatives to decrease probability of injury to workers and public.
   - Help design a robotic tool to allow remote operation.
   - Develop the necessary parts/adaptors to be used on various types (manufacturer, brand, age, etc.) of Solid Blade in Oil Rotatory Switches.

v. Deliverables
   - A working prototype for various Solid Blades in Oil Rotatory Switch tools.

vi. Metrics
   - 5a – Outage number, frequency and duration reductions.
   - 5e – Utility worker safety improvement and hazard exposure reduction.

vii. Schedule
   - 2.5 years

viii. EPIC Funds Encumbered
   - $301,808

ix. EPIC Funds Spent
   - $515,268

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.09B and 1.10B – Test New Remote Monitoring and Control Systems for T&D Assets/Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - The project focus is on development, testing, deployment, and implementation of new technologies, construction methods and techniques, and cost reduction techniques in support of the SCADA monitoring systems used on the Distribution Networks. The monitoring system consists of a complex and extensive set of components used to assess the health and condition of the network transformers on a continuous basis. This research is looking at potential failure points on the monitoring system components and what technologies and improvements can be applied to increase life expectancy of these components and reduce production and maintenance costs for this system and similar systems.

iv. Scope
   - Assess new technologies and feasibility of application on the Distribution Networks.
   - Primary focus on technologies, components and work methods to extend the life expectancy of monitoring systems equipment and reduce long term maintenance costs.

v. Deliverables
   - Modified or improved components identified for use on Distribution Network Monitoring System.
   - Improved installation and construction work methods.
   - Economic model for maintenance variables based on life expectancy testing of components.
   - Changes to components.

vi. Metrics
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 3b – Maintain/Reduce capital costs.
   - 5d – Public safety improvement and hazard exposure reduction.
   - 5e – Utility worker safety improvement and hazard exposure reduction.

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $484,250

ix. EPIC Funds Spent
- $547,681

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update
- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.09C – Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Gain operating experience with Discrete Series Reactors (DSR) to determine whether such devices would be cost effective and operate reliably and safely on PG&E transmission system.

iv. Scope
   - Install and test 90 DSR units on the Las Positas-Newark 230 kV line.
   - Install and test Server at PG&E's San Francisco General Office (SFGO) headquarters, complete with Smart Wire System Manager Software.
   - Communication links between the DSRs and server to support the DSR monitoring and control.

v. Deliverables
   - Installation, testing and analysis of DSR and server communication links.
   - Procure, construct and test the DSRs.
   - White paper describing project including go/no go recommendation.
   - Final report describing overall project, including finding from the operations and testing of DSR units and a recommendation as to whether or not to install the DSRs elsewhere in the PG&E system.

vi. Metrics
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 3b – Maintain/Reduce capital costs.
   - 5a – Outage number, frequency and duration reductions.
   - 5b – Electric system power flow congestion reduction.

vii. Schedule
   - 3.25 years

viii. EPIC Funds Encumbered
   - $1,449,835

ix. EPIC Funds Spent
   - $2,459,732

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.10A – Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Develop tools and algorithms that analyze data from monitoring equipment installed on substation equipment (distribution and transmission) that tests for dissolved gasses or other precursor data that would assist in understanding the condition of the equipment.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update
- Project not executed.

Project #1.10C – Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution

iii. Objective
- Develop tools and algorithms that analyze load and operating characteristic data from underground cables in order to develop an understanding of potential failure points, cable maintenance needs, and cable life expectancy.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update
- Project not executed.

Project #1.11 – Demonstrate Self-Correcting Tools to Improve System Records and Operations

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Transmission; Distribution

iii. Objective

- Demonstrate tools that identify and “register” existing assets to improve the integration between utility planning and operations. As part of the demonstration, implement “self-correcting” technologies that identifies plan vs. actual discrepancies and updates system records automatically.
- High priority use cases include: (1) Mapping of transformers to primary phase; (2) Mapping of customers to transformers; and (3) Precision mapping of Pacific Gas and Electric Company’s overhead and underground network.

iv. Scope

- N/A

v. Deliverables

- N/A

vi. Metrics

- N/A

vii. Schedule

- N/A

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project not executed.

Project #1.12 – Demonstrate New Technologies That Improve Wildlife Safety and Protect Assets From Weather-Related Degradation

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - Demonstrate new strategies and technologies to improve animal and bird protection, reduce outages caused by animals and birds, and protect assets from expensive weather-related degradation such as fog-related corrosion.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed.

Project #1.13 – Demonstrate New Communication Systems to Improve Substation Automation and Interoperability

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Demonstrate new strategies and technologies to convert and integrate multiple existing proprietary technologies within the substation environment for more effective operations. Substation are key operational hubs and represent significant investments, which must be further leveraged by engaging with vendors to create the next generation of interoperable substation services and products.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update

- Project not executed.

Project #1.14 – Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities

i. Investment Plan Period
  - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
  - Distribution; Grid Operation/Market Design; DSM

iii. Objective
  - This project explores and discovers effective new network applications and devices to leverage and improve the SmartMeter communications network.

iv. Scope
  - Leverage the existing SmartMeter network to support additional applications. Inform future uses of the SmartMeter network such as message capability, security, latency, and engineering constraints. Specifically focus on:
    - Test new devices to support network functions and capabilities not previously envisioned (e.g., new data streams, faster data collection).
    - Evaluate alternatives to decrease future upgrade, maintenance and/or operational costs.
    - Demonstrate different network applications, each focused on separate use cases.

v. Deliverables
  - Evaluate new applications and devices, their associated data traffic impact on the SmartMeter network, and recommend which items warrant consideration for full-scale deployment.
  - Develop business case based on findings for full deployment consideration.

vi. Metrics
  - 7f – Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation (Pub. Util. Code § 8360).
  - 7k – Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid (Pub. Util. Code §8360).
  - Note: Each technology demonstrated may have additional specific benefits to name. For instance, the following could apply: improved communication for power restoration, improved control of streetlights, etc.

vii. Schedule
  - 3.25 years

viii. EPIC Funds Encumbered

- $3,986,281

ix. EPIC Funds Spent

- $4,135,257

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- Patents filed for –
    - Smart Pole Meter
    - Smart Pole Meter Socket and
    - An algorithm to help identify downed wires

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.15 – Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; DSM

iii. Objective
- The objective of this pilot is to develop and pilot a real-time data visualization software platform for use by Electric Distribution Operations end users. Data will be integrated from various data sources and displayed on Distribution Control Center video walls and individual desktop computers, with potential for future scalability to handheld devices.

iv. Scope
- Scope includes the integration of data (network model, loading, SmartMeter devices, outages, weather, etc.) and a real-time data visualization platform for Distribution Operations.
- The Distribution Management System (DMS) platform and predictive analytics are not included in the scope.

v. Deliverables
- Demonstrate Real-time Data Visualization Platform, including data integration from a variety of data sources and a visual interface that includes geospatial, list, and trending layers.

vi. Metrics
- 5a – Outage number, frequency and duration reductions.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Pub. Util. Code 8360).
- 3a – Maintain/Reduce operations and maintenance costs.

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $1,334,030

ix. EPIC Funds Spent
- $4,133,173

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- Intellectual Property (IP) has been created through co-development with the vendor. PG&E retains ownership rights to the IP and will provide free unlimited use rights to California Investor-Owned Utilities per the California Public Utilities Commission decision

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.16 – Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Distribution

iii. Objective

- Leverage plug-in hybrid vehicle technology emerging in PG&E fleet to generate utility-grade power, supporting distribution circuits during planned or unplanned outage events.

iv. Scope

- Develop nominally 120-kilowatt (kW) exportable power capabilities from a plug-in hybrid electric truck. Seek to create the protocols necessary to safely connect the truck to the appropriate grid connection points. The portfolio of fleet vehicles (higher and lower weight classes) may broaden the range of available power ratings demonstrated by the project.

v. Deliverables

- Develop operating requirements for the vehicle.
- Understand engineering challenges with high power export with collaborative supplier development to solve.
- Develop safety and interconnection protocols to connect the vehicle to the grid leveraging existing protocols for temporary local generator set connection.
- Define and document power requirements for different outage/usage scenarios.
- Develop operating protocols (when and how the vehicles will be used).
- Develop unplanned outage protocols.
- Develop the hardware and software (if required) to connect the vehicle to PG&E's system.
- Build vehicles for field testing.

vi. Metrics

- 5a – Outage number, frequency and duration reductions.
- 5e – Utility worker safety improvement and hazard exposure reduction.
- 3a – Maintain/Reduce operations and maintenance costs.
- 4a – GHG emissions reductions (MMTCO2e).

vii. Schedule

- 3.25 years

viii. EPIC Funds Encumbered

- $ $643,840

ix. EPIC Funds Spent

- $4,009,788

x. Partners (if applicable)

- DOE/ National Renewable Energy Laboratory (NREL); Edison Electric Institute engaged for elec. utility industry staging events; Portland General Electric closely collaborating for industry-level requirements

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.17 – Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - PG&E can leverage EPIC dollars by participating and collaborating in multi-utility industry-wide research initiatives conducted by third party organizations experienced in the RD&D area. These programs would allow PG&E to cost effectively develop a deeper awareness of industry trends, access real world experience through pilot programs, and identify the gaps that utilities will fill or close with technology. For example, through participation in existing EPRI programs, PG&E would participate in and gain access to demonstrations, analyses, and results of the testing and study of distribution equipment and strategies. High Value EPRI programs include: IntelliGrid, Integration of Distributed Renewables, Energy Storage, Risk Mitigation Strategies, and Distribution Grid Modernization programs.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project not executed.

Project #1.18 – Demonstrate SmartMeter-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - DSM

iii. Objective
   - This project focuses on delivering the cost by major appliances to customers.

iv. Scope
   - This project will use the data enabled by the SmartMeter platform to provide appliance-level itemization of monthly bill charges to customers, without their completing any audit or subscribing to any new service. This project assumes that minute level meter data is available.

v. Deliverables
   - Quantify disaggregation accuracy and compare vendors.
   - Based on results, provide recommendations for deployment strategy of appliance-level billing.

vi. Metrics
   - 1f – Avoided customer energy use.
   - 1h – Customer bill savings (dollars saved).

vii. Schedule
   - 2.5 years

viii. EPIC Funds Encumbered
   - $1,399,248

ix. EPIC Funds Spent
   - $1,296,842

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.19 – Pilot Enhanced Data Techniques and Capabilities via the SmartMeter Platform

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Distribution; Grid Operation/Market Design; DSM

iii. Objective
   - The project is to explore and discover effective, new data that can be collected and studied for further benefits. Demonstrate the type of additional data that can be collected and/or processed through the SmartMeter platform. Evaluate impact of any increased data traffic on the SmartMeter network. Focus on new data collection that makes the SmartMeter platform more robust for more customers.

iv. Scope
   - Demonstrate the collection of new data from SmartMeter devices. Example use cases include:
     - Power Quality Data (C12.19 format).
     - New Data Channels.
     - Mobile data collection methods.
     - Power theft detection methodology using SmartMeter data for revenue assurance purposes.

v. Deliverables
   - Evaluate new data and analytic methodologies, their associated impact on the SmartMeter.
   - Recommendation of which data warrants consideration for full-scale deployment.
   - Evaluation should provide key inputs to a business case for general deployment.

vi. Metrics
   - 1h – Customer bill savings (dollars saved).
   - 1f – Avoided customer energy use (kilowatt-hours (kWh) saved).
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 3b – Maintain/Reduce capital costs.
   - 5d – Public safety improvement and hazard exposure reduction.
   - 5e – Utility worker safety improvement and hazard exposure reduction.
   - 5f – Reduced flicker and other power quality differences.

- 5i. – Increase in the number of nodes in the power system at monitoring points.
- 7f – Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid.

vii. Schedule

- 3.25 years

viii. EPIC Funds Encumbered

- $1,051,786

ix. EPIC Funds Spent

- $1,980,499

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.20 – Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter Data to Drive Innovation.

i. Investment Plan Period
  - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
  - Customer Service and Enablement

iii. Objective
  - This project will fund continued support of Green Button Connect (GBC). GBC provides a small number of vendors in the competitive market with automated access to recurring, machine-to-machine, programmatic data access to customer-authorized SmartMeter data in order to develop new, innovative and creative ways for customers to manage their energy consumption. GBC is a small demonstration, not scalable to support the larger customer base and wider vendor audience. PG&E is planning on implementing a robust, broader scale offering as part of its Customer Data Access project.

iv. Scope
  - N/A

v. Deliverables
  - N/A

vi. Metrics
  - N/A

vii. Schedule
  - N/A

viii. EPIC Funds Encumbered
  - N/A

ix. EPIC Funds Spent
  - N/A

x. Partners (if applicable)
  - N/A

xi. Match Funding (if applicable)
  - N/A

xii. Match Funding Split (if applicable)
  - N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Formally notified CPUC on 10-31-13, project may be terminated as refined scope does not appear to meet safety, reliability, affordability guiding principles for priority R&D.

Project #1.21 – Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability

i. Investment Plan Period
  - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
  - Distribution; DSM

iii. Objective
  - This project aims to validate and integrate a software platform to identify PV resources by leveraging Smart Meter data. This project focuses on addressing the issue of unauthorized interconnections in an automated fashion by developing and algorithm to identify resources, including integration with PG&E billing and interconnection database, as well as develop an automated outreach system for identified customers.
  - This project addresses California Public Utilities Commission proceeding, R.11-09-011 Rule 21 to support the improved distribution-level interconnection rules and regulations for certain classes of electric generators and electric storage resources.

iv. Scope
  - Identify vendor to develop or pilot software.
  - Develop integration and communication platform for auto-identification of Unauthorized Interconnections (UI).
  - Demonstrate ability to automatically integrate software with billing and interconnection.

v. Deliverables
  - Successful integration of software with PG&E's Customer Care and Billing (CC&B) system.
  - Successful tracking of all UIs identified.
  - Successful tracking of communication and "conversion" of UIs to interconnection.

vi. Metrics
  - 5d – Public safety improvement and hazard exposure reduction.
  - 5f – Reduced flicker and other power quality differences.
  - 5c – Forecast accuracy improvement.

vii. Schedule
  - 2.5 years

viii. EPIC Funds Encumbered

- $868,495

ix. EPIC Funds Spent

$1,337,825

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- Patent No. 10,557,720 Unauthorized Electrical Grid Connection Detection and Characterization System and Resource Mapping Server and System will be granted on February 11, 2020.

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.22 – Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; DSM

iii. Objective
- EV submetering pilot to test subtractive metering process and Electric Vehicle Service Provider business models.
- This project addresses CPUC D.13-11-008, which requires PG&E, along with the other two California IOUs, to pursue a submetering pilot and eventual protocol.

iv. Scope
- EV submetering pilot will entail EV Meter Data Management Agents (MDMA) delivering submeter data to IOU for subtraction from customer's primary meter to create an EV and a house bill. Customer will be responsible for both bills. In Phase 2, an additional business model will be introduced where the MDMA will be responsible for the bill to PG&E.

v. Deliverables
- Process to receive MDMA sub-metered data.
- Process to subtract EV data from primary meter to create two bills.
- Inclusion of EV portion of bill on customer's monthly bill.
- Process for billing MDMA for participant submeter charges.
- Obtain third-party evaluator for both phases of pilot through a Request for Proposal (RFP).
- Incentive payments to MDMA.

vi. Metrics
- 4a – GHG emissions reductions (MMTCO2e).
- 1h – Customer bill savings (megawatt-hours saved).

vii. Schedule
- 5 years

viii. EPIC Funds Encumbered
- $ 2,756,187

ix. EPIC Funds Spent
- $2,299,078

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2019.
- Through this project, PG&E identified key elements of third-party EV submetering solutions that will need to be improved before they are deployed to serve the state of California. PG&E identified that for third-party solutions to meet revenue-grade metering standards, improvements will need to be made in metering accuracy. Improvements will also need to be made to data transfer reliability, and a more reliable network than residential Wi-Fi should be utilized.
- Final Report is included in 2019 EPIC Annual Report.

Project #1.23 – Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Grid Ops and Market Design/Distribution/DSM

iii. Objective

- Initiative to obtain additional un-netted PV data to support customer call center bill experience, and provide additional service to its customers. PV generation data will be integrated with existing MyEnergy web portal for customers' benefit.
- This project addresses California Public Utilities Commission proceeding, Net Energy Metering R.12-11-005 and R.11-09-011 Rule 21.

iv. Scope

- Explore four different methods for obtaining PV generation data (Dedicated SmartMeter, submeter communication via ZigBee radio, third-party estimates, and data exchange with solar companies, and work with vendor to relay data to customer.

v. Deliverables

- Implement pilot program for dedicated smart meters and third-party estimates.
- Explore opportunities for submetering technology and solar company data exchange.
- Modify existing Customer Data Warehouse/MyEnergy interface to allow for additional data streams and visualization.
- Evaluate relative merits of various generation measurement/estimation approaches.

vi. Metrics

- 5c – Forecast accuracy improvements.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Pub. Util. Code 8360).

vii. Schedule

- 2.5 years

viii. EPIC Funds Encumbered

- $950,313

ix. EPIC Funds Spent

- $1,323,817

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.24 – Demonstrate DSM for T&D Cost Reduction

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission; Distribution; Grid Operation/Market Design; DSM

iii. Objective
   - Assess how to best utilize DSM resources to create a targeted customer- and location-specific approach to assist with distribution capacity constraints.
   - This project addresses CPUC's proceeding, Distribution Resources Planning R.14-08-013, through improving efficiencies between interconnection and integration.

iv. Scope
   - Improve ability to estimate Heating, Ventilation and Air Conditioning (HVAC) Direct Load Control (DLC) load impacts at the distribution feeder level to aid in better understanding of the localized impact of HVAC DLC devices on meeting distribution feeder level reliability concerns.

v. Deliverables
   - Deploy data logging devices on a scientific sample of existing SmartAC™ Cycling customers, to enable real time monitoring of device performance and load impacts at feeder-level.
   - Develop infrastructure to make real-time data available on feeder-level load impacts of SmartAC™ cycling to distribution operations.
   - Produce report describing a case study methodology of targeting and valuing customer side peak load reductions at the feeder level.

vi. Metrics
   - 7b – Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Pub. Util. Code 8360).

vii. Schedule
   - 2 years

viii. EPIC Funds Encumbered
   - $1,206,477

ix. EPIC Funds Spent
   - $1,340,353

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.25 – Develop a Tool to Map the Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs, While Reducing the Impact on PG&E's Distribution Grid

i. Investment Plan Period

- 1st Triennial (2012-2014)

ii. Assignment to Value Chain

- Distribution; DSM

iii. Objective

- Develop, pilot, and validate approaches that help determine the optimal location of DC fast chargers based on traffic patterns and distribution grid infrastructure.

iv. Scope

- Acquire travel pattern data and grid infrastructure capability data to identify low-cost, high utilization areas in which to integrate DC fast chargers into PG&E’s distribution system.

v. Deliverables

- Develop a process to identify optimal DC fast charging sites.
- Develop a map that presents the locations of optimal DC fast charging sites in a meaningful manner to customers.

vi. Metrics

- 3a – Maintain/Reduce capital costs.
- 3d – Number of operations of various existing equipment types before and after adoption of a new smart grid component, as an indicator of possible equipment life extensions from reduced wear and tear.
- 4a – GHG emissions reductions (MMTCO2e).
- 5c – Forecast accuracy improvement.
- 5d – Public safety improvement and hazard exposure reduction.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360).
- 7l – Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

vii. Schedule

- 2.5 years

viii. EPIC Funds Encumbered

- $391,425

ix. EPIC Funds Spent

- $440,769

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2016.
- Final Report was included in 2016 EPIC Annual Report.

Project #1.26 – Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources Into the CAISO Wholesale Market

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Grid Operation/Market Design and DSM.

iii. Objective
   - Develop, demonstrate and validate approaches and technologies that enable the cost-effective integration (specifically, the measurement and telemetry) of mass market DR resources into the CAISO) wholesale market. While other DR projects focus on integration of DR resources into various utility and future Independent System Operator operational needs, this project intends to test alternative telemetry solutions and technologies to satisfy CAISO operational visibility requirements.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project not executed.

Project #2.01 – Evaluate Storage on the Distribution Grid

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Transmission; Distribution; DSM

iii. Objective
   - Identify and evaluate whether system needs can be cost-effectively addressed with energy storage, including identifying a range of storage deployment locations and grid interconnection requirements on a granular level.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed.

Project #2.02 – Pilot Distributed Energy Resource Management Systems (DERMS)

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operation/Market Design

iii. Objective
   - Demonstrate new technology to monitor and control DERs to manage system constraints and evaluate the potential value of DER flexibility to the grid. The DERMS demonstration will drive learning about the people, process, and technology needed to operate the high DER penetration grid of 2025.
   - Objective 1: Define DERMS Product Requirements and Characterize PG&E DERMS Needs
   - Objective 2: Define Boundaries and Integrations with Internal and External Systems
   - Objective 3: Demonstrate Technical Feasibility of Utilizing DERMS to Manage DERs for Distribution Grid Services
   - Objective 4: Implement and Evaluate Economic Optimizations and Market Mechanisms for DER-Provided Distribution Services
   - Objective 5: Perform DERMS Deployment Readiness Assessment and Create Deployment Strategy
   - This project informs California Public Utilities Commission proceeding, Distribution Resources Plan R.14-08-013 to inform distribution planning by demonstrating DER integration into planning and operations.

iv. Scope
   - Demonstrate minimum viable DERMS operation at PG&E to address key DER management use cases.
   - The demonstration will take place in a limited geography with a diverse set of DERs being monitored and controlled by the DERMS demonstration.

v. Deliverables
   - The functional integration of a DERMS software minimum viable product and operational demonstration of the identified use cases.
   - A report that:
     - Determines the most important characteristics of a full deployment solution including detailed functional and technical requirements.
     - Identifies best practices and required internal capabilities for a full deployment solution.
     - Develops operational processes that can be scaled to a wider system deployment.

- Defines boundaries and integrations with other PG&E systems (e.g., DRMS, DMS, market systems).
- Develops a point of view on the utility role in managing DERs for grid and economic benefits.

vi. Metrics

- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360).
- 7d – Deployment and integration of cost-effective distributed resources and generation, including renewable resources (Pub. Util. Code § 8360).

vii. Schedule

- 2.75 years

viii. EPIC Funds Encumbered

- $2,535,324

ix. EPIC Funds Spent

- $6,795,385

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- $419,000

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in January 2019
- The project provided an opportunity for PG&E to define and deploy a DERMS and supporting technology to uncover barriers and specify requirements to prepare for the increasing challenges and opportunities of DERs at scale. The DERMS Demo was a field demonstration of optimal control of a portfolio of 3rd party aggregated behind-the-meter (BTM) solar and energy storage and utility front-of-the-meter (FTM) energy storage to provide distribution capacity and voltage support services while also allowing for participation of these same DERs in the CAISO wholesale market.

- Additionally, the DERMS Demo explored the ability to manage DERs that participate in wholesale markets to also provide distribution and customer services to enable DER value stacking, often referred to as multiple use applications.
- Final Report included in 2018 EPIC Annual Report.

Project #2.03A – Test Smart Inverter (SI) Enhanced Capabilities –PV

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Distribution; DSM

iii. Objective

- This project will explore the use and impact of aggregated customer-sited SIs to help inform emerging industry standards, as well as define the operational and communication requirements to support the advancement and deployment of new inverter technologies.
- This project addresses California Public Utilities Commission proceeding, Distribution Resources Plan R.14-08-013, by informing DERs modeling by incorporating SIs. The findings of this report will also support and inform PG&E's position within the Rule 21 open proceeding.

iv. Scope

- Evaluate the technical ability of SIs to influence secondary and primary voltage through field demonstrations in two distinct locations, by adjusting reactive and real power output autonomously.
- Measure customer curtailment from Volt-VAR/Volt-Watt function activation.
- Demonstrate and evaluate the reliability of communications to provide visibility, monitoring and change settings for SI-equipped PV using both a vendor-specific aggregation platform and a vendor-agnostic utility aggregation platform.
- Clarify SI technology requirements to integrate and operate SIs, and characterize challenges to deployment at scale relative to today.
- Through lab testing, understand SI performance under a range of distribution grid conditions.
- Through a vendor-led modeling effort, evaluate the impact of BTM residential PV and PV + Storage with and without SIs and perform an economic analysis of SIs on PG&E's system as compared to traditional distribution grid upgrades.

v. Deliverables

- Identify feeder(s) where SIs will be installed for demonstration.
- Demonstrate the use of residential and commercial SIs on multiple distribution feeders to demonstrate the inverters' local voltage control capabilities and power quality impacts related to high penetration of customer-sited solar PV.
- Develop necessary communications software/hardware/technologies between the utility and two different third-party SI aggregators.

- Design and implement data architectures to support satellite and cellular interaction with remote SIs.
- Quantify and qualify performance of multiple SI models from different manufacturers in lab testing.
- Implement automated Volt-VAR and Volt-Watt curves, with a quantification of ability to perform different grid services.
- Lab-test electric vehicle service equipment performance under a large range of harmonic content, to identify any chance of poor behavior.
- Through a modeling effort, provide an economic assessment of SI functions' effectiveness in deferring certain distribution upgrades associated with high DER penetration.

vi. Metrics

- 3a – Maintain/Reduce operations and maintenance costs.
- 3b – Maintain/Reduce capital costs.
- 3e – Non-energy economic benefits
- 5f – Reduced flicker and other power quality differences
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360)
- 7d – Deployment and integration of cost-effective distributed resources and generation, including renewable resources (Pub. Util. Code § 8360)

vii. Schedule

- 3.5 years

viii. EPIC Funds Encumbered

- $2,879,961

ix. EPIC Funds Spent

- $4,973,977

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in February 2019.
- This project demonstrated the functionality and grid impacts of SIs through a field demonstration, a lab testing, and modeling.
- The field demonstration targeted high voltage issues attributed to high PV penetration as well as an evaluation of a vendor-agnostic aggregation platform that allowed for the remote management of SI-enabled PV assets.
- The demonstration also used PG&E laboratory facilities to evaluate the ability of multiple vendors' SI products to execute Rule 21 SI functions and employed the EPRI to model SI performance and economic analysis on simulated PG&E distribution feeders.
- Final Report included in 2018 EPIC Annual Report.

Project #2.03B – Test Smart Inverter Enhanced Capabilities – Vehicle to Home

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Distribution; DSM

iii. Objective
   - Assessment of the use and impact of EV energy flow capabilities as a complement to the SI assessment related to PVs in project 2.03A SIs for PV.

iv. Scope
   - Technology demonstration for charging and discharging of the EV in response to DR or hard islanding events.
   - Testing multiple test modes.
   - Technology assessment from customer and ratepayer perspectives through a customer survey and a cost-benefit evaluation.

v. Deliverables
   - Evaluation of the performance of the EV energy flow capabilities to support residential load during DR and hard islanding events.
   - Cost-benefit evaluation

vi. Metrics
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 7d – Deployment and integration of cost-effective distributed resources and generation, including renewable resources.

vii. Schedule
   - 2 years

viii. EPIC Funds Encumbered
   - $225,158

ix. EPIC Funds Spent
   - $534,113

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in February 2018.
- The project demonstrated that a bi-directional EV and charger can support critical household loads through an outage. However, the project also determined that, in addition to the technology not being commercially available, it is not cost effective for customers to adopt. This was supported by the project's customer survey results which indicate the current cost estimate is roughly 4 times higher than an optimal price for consumers. Therefore, even though the project use cases were technically proven-- they are not currently feasible due to technology cost, limited market value, and other restrictions between actors (e.g. EV battery warranty coverage).
- Final Report included in 2017 EPIC Annual Report.

Project #2.04 – DG Monitoring & Voltage Tracking

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/Market Design

iii. Objective
   - Utilization of the voltage measurement capabilities of SmartMeter devices to monitor DG output and identify voltage fluctuations caused by the intermittent nature of distributed renewable resources.
   - Use of data analytics techniques and AMI (and other) data to determine the impact of PV penetration on Rule 2 violations and
   - Create rating for the probability that a Rule 2 violation is caused by DG.

iv. Scope
   - Create an algorithmic process output rating on the likelihood of a voltage violation (on a given transformer) being caused by DG fluctuations.

v. Deliverables
   - Develop an analytics process/algorithm to analyze AMI and other data for high penetration DG feeders, as well as some low penetration feeders for baselining.
   - Evaluate impact of DG penetration on voltage.

vi. Metrics
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 7b – Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Pub. Util. Code § 8360).
   - 7d – Deployment and integration of cost-effective distributed resources and generation, including renewable resources.

vii. Schedule
   - 2 years

viii. EPIC Funds Encumbered
   - $741,202

ix. EPIC Funds Spent
   - $1,233,293

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2017.
- This project demonstrated an algorithmic process for analyzing new data sources (including SmartMeter devices and databases of solar irradiance) to predict the likelihood that a Rule 2 voltage violation was caused by distributed solar generation. Solar energy is by nature intermittent, and ebbs and surges of generation can change the voltage for neighboring, downstream customers. This functionality, if integrated into a larger grid analytics platform, might improve decision making for power quality engineers responding to customer issues.
- Final Report included in 2017 EPIC Annual Report.

Project #2.05 – Inertia Response Emulation for DG Impact Improvement

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Transmission

iii. Objective

- Demonstrate the capability to emulate inertia injection and support primary frequency control using energy storage and SI technologies to potentially mitigate the impacts of large-scale DG to the grid, improve the grid performance and reliability, and advance California energy policy to increase the amounts of renewable and DG on the grid.

iv. Scope

- Develop computer models to evaluate inverter capabilities and demonstrate possible future system needs for new inertia support solutions.
- Analyze and optimize the present technology's energy storage inertial response capabilities via Power-Hardware-In-Loop testing.

v. Deliverables

- Evaluation of the power system's need for reliability support, including identifying threshold conditions.
- Assessment of the capabilities of present energy storage inverters for inertial frequency response functions.
- Provide recommendations for future inverter and interconnection requirements to provide inertial response.

vi. Metrics

- 1a. – Number and total nameplate capacity of DG facilities
- 1b. – Total electricity deliveries from grid-connected DG facilities
- 1i. – Nameplate capacity (MW) of grid-connected energy storage
- 3e. – Non-energy economic benefits (reliability)
- 5a. – Outage number, frequency and duration reductions
- 7b. – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360)
- 7d. – Deployment and integration of cost-effective distributed resources and generation, including renewable resources (Pub. Util. Code § 8360)
- 7h. – 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 (Pub. Util. Code § 8360)

vii. Schedule

- 2 years

viii. EPIC Funds Encumbered

- $589,375

ix. EPIC Funds Spent

- $1,398,027

x. Partners (if applicable)

- NREL selected as testing and demonstration provider.

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in February 2019.
- This project explored the capabilities of inverter-based energy resources to provide a set of functions related to system inertia which support the electric system.
- The project demonstrated via transmission system modeling and Power-Hardware-In-Loop testing that advanced inverter control methods can provide active power support that improves the system’s frequency response in the face of reduced conventional inertia from synchronous machine generators.
- Inverter control methods were explored including inertia-like response (derivative control) and grid-forming (voltage source) modes for respective benefits in bulk system and isolated distribution system use cases.
- Final Report included in 2018 EPIC Annual Report.

Project #2.06 – Intelligent Universal Transformer (IUT)

i. Investment Plan Period
  - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
  - Distribution; Grid Operation/Market Design; DSM"

iii. Objective
  - Develop and demonstrate a solid-state transformer field prototype Medium Voltage Fast Charger system, as an application use case of solid-state transformers for Direct Current (Direct Current) fast charging of Plug-In Electric Vehicles (PEV), featuring intelligent controls and multiple fast charging of PEVs.

iv. Scope
  - Test demonstration and communication to the same DC solid-state transformer with two protocols.

v. Deliverables
  - Develop a proof of concept that may demonstrate:
    1. An IUT can be used in lieu of other equipment to connect to Direct Current Fast Charge protocols, and
    2. An IUT can communicate back to the utility.

vi. Metrics
  - 3a – Maintain/Reduce operations and maintenance costs.
  - 3b – Maintain/Reduce capital costs.
  - 5d – Public safety improvement and hazard exposure reduction.
  - 7k – Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid.
  - 7l – Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

vii. Schedule
  - 2.25 years

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project put on hold after determining the product (IUT) was not mature enough for a technology demonstration through EPIC.

Project #2.07 – Real-Time Loading Data for Distribution Operations and Planning

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operation/Market Design; Distribution

iii. Objective
   - This demonstration will leverage interval data to improve feeder modeling, inform near real time load allocation throughout the distribution grid and transformer loading profiles, and identify opportunities to enhance current load forecasting processes for distribution transformers, feeders and substation transformers.

iv. Scope
   - Utilize AMI, SCADA, PV, GIS, weather and other data sources to develop an algorithm to improve the prediction of grid loading.
   - Develop a platform to demonstrate the ability to conduct load forecasting at scale and in near real-time

v. Deliverables
   - Develop a unique loading algorithm and metrics for assessing forecast stability and confidence.

vi. Metrics
   - 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.

vii. Schedule
   - 3.5 years

viii. EPIC Funds Encumbered
   - $1,822,317

ix. EPIC Funds Spent
   - $2,550,035

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in December 2018
- This project developed analytical methods for generating near real-time load forecast information. The project successfully built and demonstrated a platform to ingest and process SmartMeter, SCADA, PV generation, GIS, and weather data for two of the eight Areas of Responsibility within PG&E's service territory.
- Final Report included in 2018 EPIC Annual Report.

Project #2.08 – “Smart” Monitoring and Analysis Tools

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Demonstrate strategies and technologies for real time, online monitoring of substation equipment; Demonstrate communication protocols and equipment to support the smart devices; Develop visualization techniques for improved monitoring; and evaluate new vendor technologies that enable data correlation and predictive analysis to better identify and respond to potential safety, reliability and/or operational issues.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. 2018 Status Update
   - Project not executed

Project #2.09 – Distributed Series Impedance (DSI) Phase 2

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Demonstrate congestion mitigation by installing DSIs on parallel transmission facilities to demonstrate the next generation of the Distributed Series Reactor (DSR) devices from the First EPIC Triennial Plan, which may allow for better control of transmission line loading.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed

Project #2.10 – Emergency Preparedness Modeling

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - Incorporate natural hazard damage model information into one integrated algorithm/tool, which would provide the ability to quickly estimate the impacts of natural hazards on PG&E's facilities to enable faster response and restoration.
   - Provide the ability to prepare for these hazards by proactively modeling the impacts of potential hazards, to understand system vulnerabilities and restoration resource requirements.
   - Incorporate work optimization algorithms to more efficiently allocate crews.
   - Utilize artificial intelligence and statistical methods to model productive rates and automatically develop restoration plans.

iv. Scope
   - Develop optimization algorithms and visualization tool that includes asset locations and conditions with multiple potential hazards, which allows for the aggregation of equipment damage estimates (via damage models, outage information systems, and damage assessments), est. hours to repair, and recommended allocation of work resources to efficiently respond to a natural hazard.

v. Deliverables
   - Complete algorithms that aggregate data from multiple sources to feed into application.
   - Incorporate multiple algorithms into a proof of concept visualization tool.
   - Develop recommendation for deployment strategy.

vi. Metrics
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 4a – GHG emissions reductions (MMTCO2e).
   - 5a – Outage number, frequency and duration reductions.
   - 5d – Public safety improvement and hazard exposure reduction.
   - 5e – Utility worker safety improvement and hazard exposure reduction.
   - 5c – Forecast accuracy improvement.

vii. Schedule
- 3.5 years

viii. EPIC Funds Encumbered
- $2,713,522

ix. EPIC Funds Spent
- $4,227,128

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)
- PG&E will receive perpetual, transferable sublicenses to all Work Product to use for current and future PG&E business.

xv. Status Update
- Project completed in February 2019.
- This project developed the RWP system to demonstrate rapid and accurate restoration plan development for emergencies
- The project demonstrated the ability to aggregate equipment damage estimates via damage models, assessments, and outage information systems.
- It also was able to determine time needed for restoration and optimal work resources through a machine learning performance model that predicts accurate work demand and resource performance.
- A mixed integer linear programming (MILP) optimization model that considered multiple stochastic damage scenarios was built to provide resource positioning recommendations that are fast and transparent and more cost-effective and efficient.
- Final Report included in 2018 EPIC Annual Report.

Project #2.11 – New Mobile Technology & Visualization Applications

i. Investment Plan Period
  - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
  - Distribution

iii. Objective
  - Demonstrate tailored, advanced mobile applications for PG&E field operations that build upon Grid Operations Situational Intelligence (Project #15) demonstration projects in the EPIC First Triennial Plan as well as existing “baseline” mobile deployments underway.

iv. Scope
  - N/A

v. Deliverables
  - N/A

vi. Metrics
  - N/A

vii. Schedule
  - N/A

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - N/A

xi. Match Funding (if applicable)
  - N/A

xii. Match Funding Split (if applicable)
  - N/A

xiii. Funding Mechanism (if applicable)
  - N/A

xiv. Treatment of Intellectual Property (if applicable)
  - N/A

xv. Status Update
  - Project not executed

Project #2.12 – New Emergency Management Mobile Applications

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - Develop new mobile applications to enhance PG&E's emergency preparedness and response capabilities.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed

Project #2.13 – Digital Substation/Substation Automation

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Transmission; Distribution

iii. Objective

- Investigate and evaluate sustainable protection and control technologies for future “digital” substations, which may include testing technologies in a lab setting, and performing a pilot implementation to demonstrate technology adoption and integration with legacy substation protection and control technologies.

iv. Scope

- N/A

v. Deliverables

- N/A

vi. Metrics

- N/A

vii. Schedule

- N/A

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project not executed

Project #2.14 – Automatically Map Phasing Information

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Distribution; DSM

iii. Objective

- This project aims to explore a variety of pre-commercial analytics and/or hardware options to automatically map 3-phase electrical power information in order to improve the distribution network models.

iv. Scope

- Project seeks to improve distribution network models through automatic mapping of 3-phase electrical power information.

v. Deliverables

- Develop algorithm or novel process to use AMI data and other sources to determine the assignment of phases to meters and transformers.

vi. Metrics

- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.

vii. Schedule

- 2.75 years

viii. EPIC Funds Encumbered

- $1,566,518

ix. EPIC Funds Spent

- $1,937,344

x. Partners (if applicable)

- PG&E worked with UC Riverside to test an alternate algorithm-based approach which was evaluated against other solutions demonstrated in the project

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in December 2018
- This project successfully developed and demonstrated automated analytical methods for determining meter phasing and meter-to-transformer connectivity using SmartMeter, SCADA, and GIS data.
- The in-house method developed by PG&E delivered promising results and PG&E is currently working towards further improving the performance of the algorithms, so that an automated solution may be implemented at scale.
- Final Report included in this 2018 EPIC Annual Report

Project #2.15 – Synchrophasor Applications for Generator Dynamic Model Validation

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - This project will demonstrate new synchrophasor analysis applications that can perform generator dynamic model parameter estimation and validation using disturbance data recorded by the synchrophasor system. New synchrophasor applications could perform mandated generator model validation without requiring time- and labor-intensive on-site tests, and could detect sub-synchronous resonance and other conditions which can cause generator outages.

iv. Scope
   - Scope is limited to confirming that analysis of Phasor Measurement Unit (PMU) data is better than costly on-site model validation in the target geography. Scope does not include widespread deployment of PMUs.

v. Deliverables
   - Install synchrophasors (or "PMUs") on generators or generator tie-lines, and demonstrate new data analysis software applications.
   - Evaluate the application's ability to perform generator dynamic model validation by analyzing synchrophasor data following transient disturbances on the transmission system.

vi. Metrics
   - 3a – Maintain/Reduce operations and maintenance costs.
   - 5a – Outage number, frequency and duration reductions.
   - 7b – Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Pub. Util. Code 8360).

vii. Schedule
   - 3 years

viii. EPIC Funds Encumbered
   - $620,157

ix. EPIC Funds Spent

- $739,948

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in December 2018.
- The integration of PMUs on generators for dynamic model validation is a new technology and the project did not result in a tool that is production ready. As applications evolve, installation of PMUs at generating stations could potentially allow utilities to enhance their generator model validation processes.
- Final Report included in 2018 EPIC Annual Report.

Project #2.16 – Enhanced Synchrophasor Analytics & Applications

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Demonstrate new techniques to synthesize Synchrophasor data and utilize the data for advanced real-time system applications, such as wide-area monitoring, protection, and control systems, which could help move Synchrophasor applications beyond planning, forensics, and visualization to enhanced wide-area monitoring, protection, and control applications.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed

Project #2.17 – Geomagnetic Disturbance (GMD) Evaluation

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Evaluate system vulnerability to GMD by modeling GMD that occurs during a geomagnetic storm and evaluating the impact on transmission lines, interconnection lines, substations and system voltages.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed

Project #2.18 – Optical Instrument Transformers and Sensors for Protection and Control Systems

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Demonstrate newer technologies, such as optical sensors, as well as strategies and technologies to configure appropriate protection settings, including the coordination required between both new and conventional instrumentation.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed

Project #2.19 – Enable Distributed Demand-Side Strategies & Technologies

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Distribution; DSM

iii. Objective
   - Demonstrate distributed energy storage and approaches to address local and flexible resource needs.
   - This project addresses CPUC proceeding, Distribution Resources Plan R.14-08-013, by demonstrating DER locational benefits and addressing capacity constraints through aggregated BTM customer energy storage.

iv. Scope
   - Deploy an aggregation of BTM customer energy storage resources to reduce peak loading or absorb DG on a utility distribution feeder(s).

v. Deliverables
   - Demonstrate and test field results for effectiveness of the use of aggregated customer-sited BTM energy storage resources to peak load reduction and/or absorb DG on a utility distribution feeder(s).
   - Demonstrate communications with aggregated resources for visualization and control.
   - Evaluate cost-effectiveness and reliability of BTM energy storage for addressing capacity constraints.

vi. Metrics
   - 1c – Avoided procurement and generation costs.
   - 1i – Nameplate Capacity of Grid-Connected Storage.
   - 3f – Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management.
   - 5b – Electric system power flow congestion reduction.
   - 5d – Public safety improvement and hazard exposure reduction.
   - 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.
   - 7d – Deployment and integration of cost-effective distributed resources and generation, including renewable resources.

vii. Schedule
   - 2.75 years

viii. EPIC Funds Encumbered
   - $1,678,045

ix. EPIC Funds Spent

- $2,182,049

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A – No current evidence of Intellectual Property development

xv. Status Update

- Project completed in February 2018.
- Final Report included in 2017 EPIC Annual Report.

Project #2.20 – Real-Time Energy Usage Feedback to Customers

i. Investment Plan Period
  - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
  - Grid Operations/Market Design; Distribution; DSM

iii. Objective
  - Evaluate innovative feedback technologies to provide near real-time energy usage information to customers and to drive greater customer performance during DR events.

iv. Scope
  - N/A

v. Deliverables
  - N/A

vi. Metrics
  - N/A

vii. Schedule
  - N/A

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - N/A

xi. Match Funding (if applicable)
  - N/A

xii. Match Funding Split (if applicable)
  - N/A

xiii. Funding Mechanism (if applicable)
  - N/A

xiv. Treatment of Intellectual Property (if applicable)
  - N/A

xv. Status Update
  - Project not executed

Project #2.21 – Home Area Network (HAN) for Commercial Customers

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- DSM

iii. Objective

- This project will demonstrate the application of HAN technology to Pacific Gas and Electric Company's commercial customers.

iv. Scope

- This project will enable the Zigbee HAN radio on Large Commercial and Industrial (LCI) meters, to facilitate LCI customer access to real time usage data, as well as testing of the integration with existing Energy Management Systems (EMS).

v. Deliverables

- Install Zigbee HAN devices with selected LCI customers and connect devices to their SmartMeter.
- Monitor customer usage and issue/collect customer surveys.
- Complete report with identified issues and recommendations for how to integrate with an existing EMS.

vi. Metrics

- 1e – Peak load reduction (megawatts) from summer and winter programs.
- 1f – Avoided customer energy use (kilowatt-hours saved).
- 1h – Customer bill savings (dollars saved).
- 3a – Maintain / Reduce operations and maintenance costs.
- 4a – GHG emissions reductions (MMTCO2e).
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Pub. Util. Code § 8360).

vii. Schedule

- 2.25 years

viii. EPIC Funds Encumbered

- $8,451

ix. EPIC Funds Spent

- $223,476

x. Partners (if applicable)

- Rainforest Automation providing development of the cloud service application used by the customers

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in February 2018.
- Final Report included in 2017 EPIC Annual Report.

Project #2.22 – Demand Reduction Through Targeted Data Analytics

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Distribution; DSM

iii. Objective

- Identify strategic customers and target demand reduction in local areas by combining and integrating multiple DSM technologies (e.g., EE, DR, Distributed Energy Storage, and Consumer-oriented Energy Tools).
- Investigate whether PG&E can achieve a sufficient amount of demand reduction through visibility into the customer-side resources and improve the reliability of customer-side resources at the local level in order to reschedule local capacity expansion expenditures.
- This project addresses CPUC proceeding, Distribution Resources Plan R.14-08-013, by supporting the fair and transparent processes for DER deployment and integration.

iv. Scope

- Develop a solution/tool that determines needed customer demand reduction individually and in aggregate at asset level, leveraging interval and SCADA data.
- Develop cross-DER customer targeting to address forecasted capacity challenges at specific assets, for specific days and times of year, leveraging interval data and other customer attributes.

v. Deliverables

- Create a data analytics platform capable of combining and analyzing multi-structured data, linking to a variety of data sources.
- Develop a method for identification, valuation, implementation, and tracking of targeted DERs.
- Create a quantitative screening/rank order tool.
- Develop actionable DER recommendations to customer outreach teams for reaching demand reduction goals.

vi. Metrics

- 3a – Maintain/Reduce capital costs.
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.
- 7e – Development and incorporation of cost-effective DR, demand-side resource, and energy efficient resources.

- 7h – Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies.

vii. Schedule

- 2.5 years

viii. EPIC Funds Encumbered

- $656,887

ix. EPIC Funds Spent

- $1,725,022

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- Filed for provisional patent for system and server for parallel processing mixed integer programs for load management in January 2019.

xv. Status Update

- Project completed in February 2019
- This project may result in the enhancement of utility distribution planning tools and processes by facilitating the identification of the lowest cost portfolio capable of deferring, or completely mitigating, asset upgrades. Project tools produced by EPIC 2.22 consider both traditional wires solutions and DER portfolios and allows Distribution Planners to complete advanced scenario analysis.
- Following the development of these new capabilities, EPIC 2.22 tools and platforms were used to support PG&E's first DDOR. EPIC 2.22 was leveraged by PG&E to complete detailed analysis and scenario comparisons at low costs, in a timely fashion, and with a level of analytical rigor that exceed regulatory requirements.
- Final Report included in this 2018 EPIC Annual Report.

Project #2.23 – Integrate Demand Side Approaches Into Utility Planning

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Distribution; DSM

iii. Objective
   - This project will enhance Pacific Gas and Electric Company's ability to incorporate the growing usage of Distributed Energy Resources (DER) into distribution planning tools by developing new customer class load shapes that incorporate DERs, and a methodology for modeling DER deployment uncertainty at the circuit level.
   - The execution of this project addresses issues as identified in the following proceedings: Distribution Resources Plan R.14-08-013 and AB 327 Section 769, which requires transparent and consistent methods to integrate cost-effective DERs into the distribution planning process.

iv. Scope
   - Integrate a broader range of customer-side technologies and DER approaches into grid planning and operations in a least cost framework by enhancing distribution load forecasting tools to include new customer load shapes based on the usage of DERs and to model the uncertainty of DER deployment at the circuit level.

v. Deliverables
   - Develop enhanced Customer and DER Load Shapes Catalog in PG&E's LoadSEER Planning Tool.
   - Incorporate DER Scenario Projections into LoadSEER.
   - Develop interface between LoadSEER and CYME for batch processing integration.

vi. Metrics
   - 1c – Avoided procurement and generation costs.
   - 3f – Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management.
   - 5c – Forecast accuracy improvement.
   - 7e – Development and incorporation of cost-effective DR, demand-side resources, and energy-efficient resources (Pub. Util. Code § 8360).

vii. Schedule
   - 2.25 years

viii. EPIC Funds Encumbered
   - $1,831,735

ix. EPIC Funds Spent

- $3,111,449

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in 2017.
- Final Report included in 2017 EPIC Annual Report.

Project #2.24 – Appliance Level Bill Disaggregation for Non-Residential Customers

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- DSM

iii. Objective
- Demonstrate the ability to use sub-minute level usage information to determine appliance load for non-residential customers.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update
- Project not executed

Project #2.25 – Enhanced Smart Grid Communications

i. Investment Plan Period
  - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
  - Grid Operations/Market Design; Distribution; DSM

iii. Objective
  - Evaluate license spectrum providers that have developed technologies offered on the Federal Communications Commission license frequency range/spectrum.

iv. Scope
  - N/A

v. Deliverables
  - N/A

vi. Metrics
  - N/A

vii. Schedule
  - N/A

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - N/A

xi. Match Funding (if applicable)
  - N/A

xii. Match Funding Split (if applicable)
  - N/A

xiii. Funding Mechanism (if applicable)
  - N/A

xiv. Treatment of Intellectual Property (if applicable)
  - N/A

xv. Status Update
  - Project not executed

Project #2.26 – Customer & Distribution Automation Open Architecture Devices

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Distribution; Grid Operation/Market Design; DSM

iii. Objective
   - Demonstrate the means by which new customer and distribution devices could interoperate with PG&E's AMI network (IPv6).

iv. Scope
   - Demonstrate the methodology, protocols, and standards for customers and vendors to connect and communicate various new devices and applications (e.g., electric distribution equipment, distributed energy resource equipment, Radio Frequency Identification (RFID) reader, smart home devices, etc.) with the AMI network (IPv6) in an effective manner.

v. Deliverables
   - Conduct testing that will demonstrate customer and utility open architecture devices/applications that are AMI compatible, secure and interoperable.
   - Provide physical and application interfaces, as a proof of concept, which may permit customer, utility and third-party devices to connect to PG&E's AMI network(s).

vi. Metrics
   - 3f – Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management.
   - 5i – Increase in the number of nodes in the power system at monitoring points.
   - 7j – Provide consumers with timely information and control options.

vii. Schedule
   - 3.25 years

viii. EPIC Funds Encumbered
   - $1,505,338

ix. EPIC Funds Spent
   - $3,430,982

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- Non-provisional patent filed for AMI network Open Architecture System

xv. 2018 Status Update

- Project completed in February 2019.
- This project successfully demonstrated in laboratory and field tests, the ability to communicate with, monitor, and control PG&E and third-party devices in five use cases.
  - These use cases involved SIs, sensors, SCADA and other distribution intelligent electric devices, RFID equipment and Direct Acquisition and Control Telemetry.
  - These use cases were selected for their potential to improve system reliability, reduce costs, or both.
  - This project was successful in demonstrating that PG&E's AMI network can be leveraged for these additional use cases and is suitable for connecting and transmitting data from customer and utility devices.
- Final report included in 2018 EPIC Annual report.

Project #2.27 – Next Generation Integrated Smart Grid Network Management

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Distribution; DSM

iii. Objective

- Evaluate new technologies to holistically monitor, control and evolve the communications network and supporting infrastructure as a platform to enable Smart Grid solutions.

iv. Scope

- Demonstrate a new AMI Network management system to holistically monitor, control, and evolve the existing AMI network and infrastructure from a billing-centric platform to a fully operational AMI solutions platform that will meet evolving customer and grid needs.

v. Deliverables

- Demonstrate an integrated, multi-tenant network management system that may include the following features:
  - Integrated network management and control that will monitor and prioritize data traffic.
  - Automate trouble ticketing creation process for workflow management.
  - Asset management of meter and network equipment regardless of meter or network types.

vi. Metrics

- 3a – Maintain/Reduce operations and maintenance costs.
- 5a – Outage number, frequency and duration reductions.
- 5d – Public safety improvement and hazard exposure reduction.
- 5e – Utility worker safety improvement and hazard exposure reduction.

vii. Schedule

- 3 years

viii. EPIC Funds Encumbered

- $576,433

ix. EPIC Funds Spent

- $1,134,144

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in August 2018.
- Developed a demonstration grade management platform that successfully identified inventory, configuration, and performance data for all three AMI networks including both networking elements and metering endpoints.
- The project learned the complexity of adding functions needed such as additional Head-End Network Management functions, integration with GIS layers (i.e., data sources like CC&B, MDMS), and integration with various PG&E ticketing systems (Remedy, FAS). Based on this complexity, an enterprise management system will be needed to scale the functions demonstrated through this project.
- Final report included in 2018 EPIC Annual report.

Project #2.28 – Smart Grid Communications Path Monitoring

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operation/Market Design

iii. Objective
   - Evaluate communication paths for AMI related messages, including methods to clear potential interference, congestion, validate proper authorizations, and grant clearances for sending message over a secured communication path.

iv. Scope
   - Determine the ability to identify, analyze, and diagnose RF interference that can occur along the communication path from the meter through the data collectors to the AMI vendors' control system.

v. Deliverables
   - Establish the baseline noise floor.
   - Develop and demonstrate an application with an algorithm which can automatically and continuously identify, monitor, and confirm RF interferences for multiple spectrums.
   - Provide an end-end process for identifying, confirming and mitigating detected interferences with the AMI-network.

vi. Metrics
   - 1h – Customer bill savings (dollars saved).
   - 3e – Non-energy economic benefits – reduction operational hours to fix estimated bills due to RF Interference.

vii. Schedule
   - 1 years

viii. EPIC Funds Encumbered
   - $58,518

ix. EPIC Funds Spent
   - $251,869

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project completed in February 2018.
- Final Report included in 2017 EPIC Annual Report.

Project #2.29 – Mobile Meter Applications

i. Investment Plan Period
  - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
  - Grid Operations/Market Design; Distribution; DSM

iii. Objective
  - Demonstrate the utility's ability to enable dynamic electric mobile metering.

iv. Scope
  - Develop and test a mobile meter prototype on various applications that can be used to capture and monitor real-time energy transactions and usage (e.g. PEV, DG, mobile storage, etc.).

v. Deliverables
  - Design specification of mobile meter.
  - Demonstration of mobile meter hardware prototype.
  - End-to-end meter to cash testing using existing AMI or cellular based network.
  - Demonstration of use-cases on DG applications and PEV metering, including remote and near real-time tracking of vehicle charge locations and energy flow.

vi. Metrics
  - 3a – Maintain/Reduce operations and maintenance costs (Affordability).
  - 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Reliability).
  - 7j – Provide consumers with timely information and control options (Customer).

vii. Schedule
  - 3.5 years

viii. EPIC Funds Encumbered
  - $1,709,700

ix. EPIC Funds Spent
  - $2,567,714

x. Partners (if applicable)
  - Lawrence Livermore National Lab providing technical support for product development

xi. Match Funding (if applicable)
  - N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- Non-Provisional patent Resource Meter System And Method (16/143,295) filed for the multi-purpose mobile meter (NGM).

xv. Status Update

- Project completed in February 2019.
- Conducted functional and acceptance testing on alpha and beta NGM prototypes.
- Demonstrated mobile application of NGM prototype at PG&E
- Refined integration of accelerometer into the NGM
- Designed, implemented, and tested C12.19 and head end applications into NGM
- Final report included in 2018 EPIC Annual report.

Project #2.30 – Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Transmission; Distribution; DSM

iii. Objective
   - Leverage EPIC dollars by participating and collaborating in multi-utility, industry-wide research, demonstration and deployment initiatives conducted by third-party organizations.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Project not executed

Project #2.31 – Aggregated Behind-The-Meter Storage Market/Retail Optimization

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; DSM

iii. Objective
   - Demonstrate how aggregated behind-the-meter energy storage systems that are operated by a third-party dispatcher may address wholesale market needs, while also operating as a customer resource to reduce customers' retail electric bills.

iv. Scope
   - N/A

v. Deliverables
   - N/A

vi. Metrics
   - N/A

vii. Schedule
   - N/A

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)
   - N/A

xv. Status Update
   - Formally Withdrawn by PG&E on 07/31/2017 via PG&E Comments on Draft Res.E-4863.

Project #2.32 – Electric Load Management for Ridesharing Electrification

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Distribution; DSM

iii. Objective

- Evaluate grid impacts from EV charging used for ridesharing applications, to assess the ability to manage the resulting load using active demand management.

iv. Scope

- N/A

v. Deliverables

- N/A

vi. Metrics

- N/A

vii. Schedule

- N/A

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Deferred to a future investment plan by CPUC. Res.E-4863. 08/10/2017.
- Re-assigned as EPIC 3.42.

Project #2.33 – Service Issue Identification Leveraging Momentary Outage Information

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Distribution

iii. Objective

- Leverage multiple sources of data, including but not limited to SmartMeter™, time of day, location and weather data, to proactively identify potential problems in the Electric T&D system, specifically related to identifying locations with high incidences of momentary outages which may be caused by imminent failures of conductors, insulators, transformers and/or vegetation contact.

iv. Scope

- N/A

v. Deliverables

- N/A

vi. Metrics

- N/A

vii. Schedule

- N/A

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Deferred to a future investment plan by CPUC. Res.E-4863. 08/10/2017.
- Re-assigned as EPIC 3.43.

Project #2.34 – Predictive Risk Identification with RF Added to Line Sensors

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Distribution

iii. Objective
   - Demonstrate distribution sensor products that provide indicators of imminent asset failure and real-time monitoring of PG&E rights-of-way

iv. Scope
   - Assess technical feasibility of various sensor products and validate opportunity for business benefits
   - Develop solution designs, develop test plans, and conduct testing at ATS
   - Conduct field demonstrations of various products and develop post-EPIC roadmaps for integrating capabilities in production

v. Deliverables
   - Roadmap for integrating additional sensor technologies in production

vi. Metrics
   - 3a – Maintain / Reduce operations and maintenance costs
   - 5a – Outage number, frequency and duration reductions
   - 5d – Public safety improvement and hazard exposure reduction

vii. Schedule
   - 2 years

viii. EPIC Funds Encumbered
   - $2,370,131

ix. EPIC Funds Spent
   - $3,147,006

x. Partners (if applicable)
   - N/A

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - N/A

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project is in the Build/Test phase.
- Completed field testing of mobile RF-based sensors from Exacter Technologies.
- Field demonstration of Early Fault Detection system underway on live distribution circuits. Technology employs use of pole-mounted RF-based sensors for incipient fault detection. Testing to be completed by June 2020.
- Field demonstration of Distribution Fault Anticipation (DFA) technology underway. DFA analyzes voltage and current waveform data to detect faults using equipment installed at substations. Testing to be completed by June 2020.

Project #2.35 – Call Center Staffing Optimization

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operations/Market Design

iii. Objective
- Optimize call center staffing by developing a real-time algorithm that integrates with and improves upon existing call center staffing software to potentially predict variability in call volume impacts in near real-time.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update
- Rejected by CPUC. Res.E-4863. 08/10/2017.

Project #2.36 – Dynamic Rate Design Tool

i. Investment Plan Period

- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain

- Grid Operations/Market Design; DSM

iii. Objective

- Develop a new rate design tool that will enable complex rate design such as for DER adoption, with a more robust, quicker and powerful rate design approach than the current rate design process. Leveraging big data technologies, the tool will provide rapid optimization, analysis and evaluation of hypothetical new rate structures which will enable PG&E and parties in a rate case to make rate design decisions based on full information and nuanced sensitivity analysis.

iv. Scope

- Design and build cost of service database
- Design and build rate design model engine and API
- Build functionality and ability to run DER scenarios

v. Deliverables

- Technical architecture specifications
- Data model and databases
- Rate design model engine and API

vi. Metrics

6a. Reduction of time to complete the process of designing, optimizing, and analyzing the impact of a hypothetical rate design

vii. Schedule

- 1.25 years

viii. EPIC Funds Encumbered

- $585,440

ix. EPIC Funds Spent

- $1,107,409

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Update

- Project is in Close-out phase.
- Completed field testing of mobile RF-based sensors
- Field demonstration of Early Fault Detection system underway on live distribution circuits. Technology employs use of pole-mounted RF-based sensors for incipient fault detection. Testing to be completed by June 2020.
- Field demonstration of DFA technology underway. DFA analyzes voltage and current waveform data to detect faults using equipment installed at substations. Testing to be completed by June 2020.

Project #3.01 – Automated DER Impact & Long-Term Dynamics Evaluation

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Distribution

iii. Objective
   - Automate the DER impact and long-term dynamics evaluation processes leveraged in detailed engineering analysis in order to aim to reduce DER study timelines and costs, while also seeking to support distribution engineers to better understand and manage the voltage impacts caused by multiple DERs on a single circuit and on LTC operations. The automated evaluation modules would produce a report showing device loading, steady state voltage analysis, and voltage flicker analysis. The long-term dynamics module could potentially further identify potential voltage issues that may lead to Electric Rule 2 violations.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.02 – Utility Aggregated Resources With Market Participation

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Distribution

iii. Objective
   - Demonstrate multi-technology DER aggregation (e.g., solar, storage) for wholesale market operations with potential to explore multiple uses including distribution support, retail, and/or T&D interfaces for control center operations. Developing this more automated optimization solution may enable realization of additional value from DERs with minimal operator intervention or disruption to operations. This equals more effective utilization of DG assets, which may include enhanced bidding in real-time to enable realization of additional wholesale market value from DERs or enhanced reliability by providing an indication of whether the current state of the grid is configured in a way that allows bidding into the CAISO market.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.03 – Distributed Energy Resource Management System (DERMS) and ADMS Advanced Functionality

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Distribution; Transmission; DSM

iii. Objective

- To incorporate additional DER technologies and grid management approaches into DERMS and/or ADMS to build upon efforts from the EPIC 2.02 DERMS project to support improvements to safe and reliable grid operations at the T&D market interface, while also enabling the presence of high penetrations of market participating DERs. This would demonstrate the orchestration of a comprehensive DER portfolio and also address the new operational challenges for DOs caused by emerging opportunities for DERs to participate in wholesale markets via the DERP tariff.

iv. Scope

Project Phase 1 – DER Registration, Verification, and Monitoring:

- Design, assess, procure, and deploy a standardized SI head-end platform to communicate with a minimum of 2 individual DERs or Aggregator cloud platforms. The interface must be compliant with CSIP 2.1 requirements to enable vendor agnostic communication and be cybersecure.
- Design, develop, and deploy an interface between SI head-end platform and DMS/SCADA to enable operator visibility of DER telemetry information.
- Conduct a field demonstration for the following foundational capability with multiple (at least two) individual DERs or Aggregators:
  - Dispatch registration data request to SI-based DERs, and ingest monitoring and registration data from DERs.
  - Display DER telemetry data in distribution DMS/SCADA for operator visibility

Project Phase 2 – Integration with EMS/DMS/SCADA and DER dispatch:

- Expand SI head-end platform capabilities to dispatch control signals to SI-based DERs either directly or through Aggregator cloud platforms. The interface must be compliant with CSIP 2.1 requirements and the control capabilities must include:
  - Dispatch of real-time signal to connect/disconnect DERs
  - Dispatch of real-time signal to limit maximum active power
  - Dispatch of day-ahead capacity constraint signals
  - Dispatch of seasonal or day-ahead load/generation schedule
  - Dispatch short term distribution grid capacity constraints
- Design, configure and deploy customized dashboards for distribution operators to visualize, dispatch, and control DERs for both the remote grid application, and the non-wires alternative solution.

Note: The distribution grid constraint for DERs participating as a NWA resource will be generated using a substation load/generation forecasting model that will be developed outside of EPIC 3.03 scope.

Conduct a field demonstration of the following capabilities with multiple (at least two) individual DERs or Aggregators that enable the use cases defined above:

- Display DER situational awareness data for DERs operating in off-grid stand-alone systems and allow operators targeted control options to manage the DERs.
- Based on operator request, perform a day-ahead scheduled load/generation dispatch of DER resources directly or through an Aggregator platform. Confirm and verify the DER response.
- Dispatch day-ahead or seasonal capacity constraints to DER resource interconnected with constrained generation agreement. Confirm and verify the DER response.
- Dispatch short term capacity constraints to DER resources directly or through an aggregator platform. Confirm and verify the DER response. If the response of DER resources do not conform with the constraints provided, disconnect the DER or curtail generation.

v. Deliverables

- PHASE I
  - Detailed scope and charter created and approved
  - Location/feeder selection finalized for each use case
  - Initial solution design completed, and RFP released for DERMS vendor
  - DERMS vendor selected and contract terms finalized June
  - Multiple (at least two) individual DERs and/or aggregators contracted for participating in field demonstration –
  - Vendor software acceptance test completed for Phase 1 functionalities
  - DER assets deployed, and Aggregator platforms prepared for field demonstration
  - Demonstration of Phase 1 functionalities completed – April 2020
  - Established operating protocol and procedure. Prepared path to production documentation for Phase 1 functionalities
- PHASE II
  - System requirements developed to expand the SI Head-end platform capabilities to establish two-way communication for demonstrating Phase 2 use cases
  - Vendor software acceptance test completed for Phase 2 functionalities
  - DER assets deployed, and Aggregator platforms prepared for field demonstration at one remote grid site and one Non-Wires alternative site. The NWA field demonstration will be conducted in an area that will allow PG&E to de-risk the grid and/or PG&E customers. The field demonstration will be located either serve a grid need in an area with high potential to be affected by PSPS but not eligible as a resilience zone or in an area that is part of a disadvantaged community. The business sponsor

will review and agree on site selection for both field deployments before they occur.

- Demonstration of Phase 2 functionalities completed
- Established operating protocol and procedure. Prepared path to production documentation for Phase 2 functionalities

vi. Metrics

7-b: Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)

7-c: 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 (PU Code § 8360)

7-d: Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360)

7-j: Provide consumers with timely information and control options (PU Code § 8360)

7-l: Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services (PU Code § 8360)

9-c: Number of times reports are cited in scientific journals and trade publications for selected projects.

9-d: Successful project outcomes ready for use in California IOU grid (Path to market)

vii. Schedule

- 2 Years

viii. EPIC Funds Encumbered

- $363,600 (directly awarded contracts)

ix. EPIC Funds Spent

- $620,223

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project approved and started in July 2019
- This project will design, procure, and deploy a prototype of an enterprise DERMS platform to develop a cost effective non-SCADA solution for providing situational awareness and control capabilities for operators to manage DERs, dispatch DER Registration data requests and monitor Smart Inverter-based DERs through head-end platform, and provide an interface to dispatch DERs as a remote grid and NWA.

Project #3.04 – Multi-Nodal Distributed Digital Ledger

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Distribution; Generation; DSM

iii. Objective

- Demonstrate and evaluate a multi-nodal digital distributed ledger (i.e., Blockchain) as an enabling technology that may facilitate greater efficiency, transparency, and security for customers. The project results may illuminate certain blockchain use cases that provide the most benefit to the utility and its customers and provide greater understanding regarding challenges associated with technology scalability, the blockchain interface with the grid, and current business processes and the application of smart contracts and other similar algorithms in a distributed environment.

iv. Scope

- Build blockchain solution for materials traceability by tracking the Company's use of steel reels.
- Build blockchain solution for the trading of incremental EV credits in the residential market for LCFS.

v. Deliverables

- TBD

vi. Metrics

- TBD

vii. Schedule

- 18 months

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $(52)

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is in planning phase.

Project #3.05 – Virtual DER Markets for Capacity and Other Attributes

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Distribution; DSM

iii. Objective
   - To demonstrate the feasibility and the technological and/or economic performance of autonomous distributed economic dispatch in the context of DER markets for capacity and other attributes. There is no technology standard in the industry today for responding to multiple conflicting signals across the Generation-Transmission-Distribution-Customer value chain. The objective of the project is to test flexible demand, generation and storage, and reward local people and businesses for being more flexible with their energy.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.06 – Auto Identification (AutoID) of Behind-the-Meter (BTM) Storage

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Distribution; DSM

iii. Objective
   - To bridge the knowledge gap for storage's charge and discharge behavior in the field, as well as system impacts by analyzing storage charge/discharge patterns.
   - Under current Net Energy Metering Policy, BTM Storage is not required to be on a separate submeter. This could lead to a situation where the utility would not be aware of the presence of storage, which could potentially impact safety and reliability of the distribution network. Additionally, understanding of the "net" storage impact at the feeder-level and secondary circuit level is important as distribution planning engineers begin to include DERs in their load forecasts.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.07 – Utility Scale Storage for Load Balancing

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design

iii. Objective
   - To demonstrate phase load balancing by leveraging large, utility-owned batteries. Removing manual work to rebalance loads improves operational efficiency by reduced manual hours spent, improves reliability by optimizing asset utilization across phases with faster adjustment of controls, and improves safety by removing manual labor for managing large loads.

iv. Scope
   - TBD.

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.08 – Second-Life Batteries for Grid Needs

i. Investment Plan Period
- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
- Grid Operations/Market Design; Distribution; DSM

iii. Objective
- To demonstrate technology that enables second-life energy storage for key utility functions, such as DR and/or frequency regulation, which may lower energy storage costs and support EV business cases with residual value.
- Technology may also be developed for ensuring that second-life batteries can successfully interface with the grid. Building off PG&E's prior energy storage EPIC pilots, this project may identify significant technical or performance differentiations between a second-life storage system and an installation with new batteries, and

iv. Scope
- TBD

v. Deliverables
- TBD

vi. Metrics
- TBD

vii. Schedule
- TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.09 – Dynamic Near-Term DER Load Forecasting

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design, Distribution; Generation, Transmission, DSM

iii. Objective
   - This project proposes to collect and combine SI data with other data streams (e.g., local weather, customer demographics, and/or customer usage) to create an algorithm that can better predict customer gross and net usage/load, DER generation, back-feed at distribution assets, and impact on system level or local short-term energy supply needs. Beginning in September 2017, California's Rule 21 requires SIs for all new customer-connected generation and storage devices.
   - Having better insight into the impact of DERs on generation and distribution system needs, the utility, in coordination with the CAISO, may be able to reduce the generation purchasing buffer required. Further, the utility could better understand and model/predict the impact of DERs on the distribution system. This could reduce operating cost and in turn potentially lower customer bills.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.10 – Grid of the Future Scenario Engine

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Transmission; Distribution; DSM

iii. Objective
   - To develop a wide-scale distribution and/or transmission grid simulator for analyzing multiple scenarios and potential future stressors to the grid, such as changes in usage behavior, increased DER integration rates and more to facilitate better informed grid planning.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. 2018 Status Update
   - Project is currently on hold.

Project #3.11 – Location-Specific Options for Reliability and/or Resilience Upgrades

i. Investment Plan Period
- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
- Grid Operation/ market design; Distribution; DSM

iii. Objective
- To create the processes and demonstrate the scoping, specification, and deployment of multiple DER technology configurations that could potentially serve as location-specific options for distribution system reliability and/or resilience upgrades.

iv. Scope
- Technology configurations to be evaluated for their ability to provide distribution service reliability and/or resilience may include distributed battery storage, distributed solar and other DG, microgrid controllers, and isolation and protection equipment enabling islanding.
- If a microgrid alternative is identified and selected in the -41- distribution planning process, this project may include a field deployment and evaluation of the selected alternative.
- The relatively immature microgrid market is characterized by a wide range of custom projects with little standardization in technology and design. This project may help identify deployment options and test the efficacy of microgrid-related technologies (e.g., DERs, controllers, communications, and isolation and protective devices) in enhancing reliability and/or resilience in specific locations.

v. Deliverables
1. Initial microgrid designs and Wholesale Interconnection application support completed
2. Testbed design plan and initial DER component procurement
3. Experimental tariff frameworks for microgrid infrastructure cost recovery and islanding generation support (Initial Design)
4. Cybersecurity Protocols (initial Design with project partners) Interconnection and service planning requests completed
5. Test protocols for grid connected and islanded planned and unplanned simulations developed
6. The physical microgrid DER components in a PHIL simulation environment, including protections and local communication are developed
7. Field site and host circuit upgrades completed

8. Microgrid controller testing and verification completed
9. All microgrid components staged and ready for field deployment
10. Training for field and control center personnel completed
11. SCADA integration, automatic and manual operating protocol and procedure are established
12. Arcata airport microgrid field deployment and installation
13. Microgrid commissioning
14. Initial data collection and use-cases testing are completed
15. Public final report delivered

vi. Metrics

- 5a – Outage number, frequency and duration reductions
- 5d – Public safety improvement and hazard exposure reduction
- 9a – Description/documentation of projects that progress deployment, such as Commission approval of utility proposals for wide spread deployment or technologies included in adopted building standards

vii. Schedule

- 2 Years

viii. EPIC Funds Encumbered

- $188,432 (directly awarded contracts)

ix. EPIC Funds Spent

- $695,354

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is in Build/Test phase.
- Location of the demonstration has been identified (Arcata/Eureka airport).
- Lab-scale testing of the microgrid controllers and battery storage solutions are in progress at PG&E (ATS)
- Interconnect and design studies are being performed by PG&E, Humboldt State University, and Redwood Coast Energy Authority.

Project #3.12 – Advanced Volt/Var Optimization (VVO) Functionalities

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operation/ market design; Transmission; Distribution

iii. Objective
   - This project would seek to demonstrate enhanced algorithms to leverage VVO for grid management services.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.13 – Transformer Monitoring via FAN

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design; Distribution

iii. Objective
   - This project will seek to demonstrate equipment that can be quickly and safely mounted on the casing of a pole-top distribution transformer to enable monitoring of equipment health. Additionally, it may test new communication devices and processes for delivering sensor data through PG&E's FAN.
   - The benefits of a successful solution deployed at full scale based on the learnings of this project may include:
     - Preventative Maintenance/Replacement of Transformers (Reliability, Safety) PG&E has over one million distribution transformers in service, which are replaced at a rate of ~2.5 percent per year. Identifying transformers that are approaching end of life could allow preventative replacement, reducing the chances of unplanned outages and potential safety concerns.
     - Improved Understanding of "Plug and Play" Equipment Installation (Affordability) Developing new methods to attach sensors to field equipment easily, and streamline the process of connecting their outputs to centralized data management systems is an important goal to reduce the cost of installation for new smart grid devices.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is in planning phase.
- Business plan is being drafted to plan for a field demonstration of approximately 500 temperature sensors to be installed on operational service transformers.
- Project is planned to start in Q2 2020.

Project #3.14 – Maintenance Prioritization for Imminent Asset Risk

i. Investment Plan Period
- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
- Grid Operation/ market design; Transmission; Distribution

iii. Objective
- To demonstrate the convergence of asset and operational data with historical maintenance information and proactive identification of potential equipment failures.

iv. Scope
- N/A

v. Deliverables
- N/A

vi. Metrics
- N/A

vii. Schedule
- N/A

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A

xv. Status Update
- Project merged with 3.20

Project #3.15 – Proactive Wires Down Mitigation

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operation/ market design; Distribution

iii. Objective

Demonstrate methods for automatically & rapidly reducing the flow of current and risk of ignition in single phase to ground faults in PG&E's high risk fire areas. This project would test the hypothesis that resonance grounding can mitigate single line to ground fire ignition risk for 3-wire circuits in high fire risk areas. A secondary objective is to improve reliability during wildfire season over status quo, "trip feeder and drive entire line."

iv. Scope

- This project would seek to demonstrate technology that could identify a falling conductor in sub-second response time, to enable proactive circuit isolation. If proven successful, the algorithm could be integrated with grid management systems to minimize safety risks in wires down situations.

v. Deliverables

Build, test, and make operationally ready the REFCL technology.

- Phase 1: Engineering and Construction
  - Project design
  - Equipment order
  - Test in Proof of Concept RTDS Lab
  - Field and substation work
  - Train and educate all departments affected by this technology
- Phase 2: Field Demonstration & Operation
  - Commissioning & testing
  - Fault location testing

vi. Metrics

- 3a – Maintain/Reduce operations and maintenance costs.
- 4a – GHG Emissions Reductions (MMTCO2e)
- 5a – Outage number, frequency and duration reductions

vii. Schedule

- 2 years

viii. EPIC Funds Encumbered

- $2,794,154 (directly awarded contracts)

ix. EPIC Funds Spent

- $1,853,997

x. Partners (if applicable)

- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is in planning phase.
- Project is in the Build/Test phase.
- Performed RFP process and identified equipment supplier for four key contracts. Execution of contracts began in Q3 2019, and remaining contract that went through competitive process will be executed in Q1 2020.
- Identified substation for demonstration and began civil engineering work to prepare the site. Distribution engineering and construction work to begin in mid-2020.

Project #3.16 – Advanced Condition Monitoring for Remote Diagnostics

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operation/ market design; Transmission; Distribution

iii. Objective
   - To demonstrate advanced real-time sensors for monitoring asset conditions, enabling an increasingly proactive maintenance and grid management operational model. If proven successful, these sensors could help PG&E estimate equipment's remaining service life, and predict when it may fail.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.17 – Generic Universal Distribution Controller (UDC) for Relay, Regulator, LTC, Capacitor, Interrupter Control

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operation/ market design; Distribution

iii. Objective
   - Design and demonstrate a UDC that can act as a generic controller for use in electric distribution line equipment. This approach could potentially standardize controller hardware across operational control functions insuring interoperability and reducing the need for -51- redundant maintenance and management for multiple vendors. It may also permit customization of features through software development control specific to the utility's needs.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.18 – Transformer Health Monitoring

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - To develop and demonstrate new algorithms for determining and actively monitoring transformer health and performance based on Synchrophasor or other technology to detect conditions, such as arcing, breaker mis-operation, or total fault energy over time. The project could enable higher accuracy asset monitoring and predictive failure analytics.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.19 – Unified Network Solution

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design; Transmission; Distribution

iii. Objective
   - To demonstrate a platform for unified communication among disparate networks both in the field, as well as across the enterprise. This project may improve reliability by ensuring communication service across multiple service platforms and help to reduce reliability risk by ensuring that the systems can rely on each other's backhaul for redundancy.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.20 – Data Analytics for Predictive Maintenance

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operations/ market design; Distribution; DSM

iii. Objective

- To develop predictive maintenance algorithms for identifying potential asset failures before they occur by using SmartMeter voltage data and other utility data sources at service points downstream of equipment. The project would potentially improve system reliability and safety by reducing unplanned outages by proactively identifying and mitigating equipment failure.

iv. Scope

- The project would define a set of failing equipment use cases that have impact on downstream voltage, and develop analytics algorithms to identify the voltage signatures associated with these upcoming failures. Examples of potential equipment use cases include primary side loose neutrals and overloaded or near-failure transformers, and stressed or near-failure cables.

v. Deliverables

- The output of the project would be an analytics process that would correlate and detect pattern signatures that are associated to malfunctioning or failing system assets, a set of heuristics for identifying these signatures, and an evaluation of this technology's efficacy versus traditional condition-based maintenance systems.

vi. Metrics

- 3a – Maintain / Reduce operations and maintenance costs
- 5a – Outage number, frequency and duration reductions
- 5d – Public safety improvement and hazard exposure reduction
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)

vii. Schedule

- 1.75 years

viii. EPIC Funds Encumbered

- TBD

ix. EPIC Funds Spent

- $756,701

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is in planning phase.
- Project is in Build/Test phase.
- Identified three use cases to develop predictive analytics model.
- Model currently under development for service transformer use case using historical failure data.
- Use cases on network transformers/regulators and underground cables to be explored.

Project #3.21 – Advanced Vegetation Management Insights Using Prescriptive Analytics

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/market design; Transmission; Distribution

iii. Objective
   - To demonstrate a prescriptive analytics model that predicts tree growth rates and areas at highest risk for vegetation-related outages by leveraging Light Detection and Ranging (LiDAR), other remote sensing data, and historical vegetation-based outages for proactive and targeted mitigation. The model could be used for routine maintenance activities, reliability-focused project planning, or planning and staging in anticipation of strong weather systems impacting the PG&E service system.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is in planning phase.

Project #3.22 – Abnormal State Configuration Risk and Mitigation

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/market design; Distribution

iii. Objective
   - To demonstrate an algorithm for understanding the comparative risk of abnormal state configurations to proactively prioritize mitigation of these issues. The project would explore the use of system data to analyze risk impact and attempt to demonstrate an algorithmic approach to automate the impact score. This project may also explore the best approaches to integrate this algorithm into utility systems and processes, as well as potentially automate the resolution of these issues.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.23 – Enhanced Distribution Line Equipment Device Settings Management

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/market design; Distribution

iii. Objective
   - To demonstrate the increased efficiency, quality assurance, and flexibility of technology to manage transmission and substation distribution protection relay device settings to all distribution line equipment relays and controllers.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.24 – Automatic Power Factor (PF) Management

i. Investment Plan Period
- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
- Grid Operations/ market design; Distribution; Transmission

iii. Objective
- To demonstrate a software algorithm to achieve Automatic PF Management to keep power factor within the mandated CAISO guideline.

iv. Scope
- TBD

v. Deliverables
- TBD

vi. Metrics
- TBD

vii. Schedule
- TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Update
- Project is currently on hold.

Project #3.25 – Electric Grid Monitoring Meter

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design; Distribution

iii. Objective
   - To develop and demonstrate a modular-designed meter with the capability to monitor electric grid operations and report real time outage and restoration, as well as function as a SCADA metering point during the critical and initial 10-30 minutes of a power outage. This may help keep PG&E distribution system operators well-informed of grid outage conditions and assist them in taking appropriate actions to restore customer power quickly.
   - The new meter demonstrated in this project could enable potential reduction of equipment costs for replacements due to its modular design. The base mechanical meter would more rarely need replacement, typically leaving just the replacement of the solid-state meter and communication core component as needed.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.26 – Predictive Data Analytics for Proactive Meter Replacement

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Distribution

iii. Objective
   - To develop and demonstrate a predictive analytics tool for remotely diagnosing meter health, to target and prioritize proactive meter replacements. The project will seek to explore the development and demonstration of an algorithm, software application/tool, and/or system interfaces to predict when a meter has a potentially unsafe condition, identify service connection issues, and/or identify when a meter is failing.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.27 –MPM

i. Investment Plan Period
  - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
  - Grid Operations/market design; Distribution

iii. Objective
  - To develop and demonstrate a meter that can measure energy consumption for multiple customers and/or multiple uses/purposes, in the place of multiple single-use/purpose and/or submeters. The MPM will include a combination of head-end operations applications, master meter, and individual meters. This solution will cut down the components inside electric meters and reduce the material costs, meter installation and maintenance costs at the same premise. The combination of power enclosure and MPM box will also be small and take less space inside the building.

iv. Scope
  - TBD

v. Deliverables
  - TBD

vi. Metrics
  - TBD

vii. Schedule
  - TBD

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $316

x. Partners (if applicable)
  - TBD

xi. Match Funding (if applicable)
  - TBD

xii. Match Funding Split (if applicable)
  - TBD

xiii. Funding Mechanism (if applicable)
  - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. 2018 Status Update

- Project is in planning phase.

Project #3.28 – Real-Time Load-Based Charging

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design; Distribution; DSM

iii. Objective
   - The project would attempt to develop a smart-charging algorithm based on time, capacity, locations, and other inputs. The algorithm would aim to coordinate EV charging so that specific grid assets are not overly taxed. This project could design controls to coordinate EV charging in a local area in order to facilitate higher EV adoption and charging without the need for distribution system upgrades.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.29 – Advanced Customer Bill Scenario Calculator

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design

iii. Objective
   - To demonstrate an online tool with a streamlined graphical user interface to allow customers to more easily understand how behavioral changes and technology investments may affect their energy bill. The proposed tool is targeted towards the group of more engaged customers. PG&E's customer research shows that the more engaged customers want to understand how technologies may affect their bills. In response to this market need, this tool would allow consumers to engage with their energy usage and conservation options through an interactive and more in-depth manner.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- After nearly completing the business plan, this project was put on hold and is still currently on hold..

Project #3.30 – Connected Device Real-Time Pricing-Based Control

i. Investment Plan Period
- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
- Grid Operations/ market design; DSM

iii. Objective
- To demonstrate the technical feasibility, utility benefits, and customer value of real-time pricing services through evaluating how PG&E can send signals to connected devices to control their operation based on pricing signals and/or grid conditions. This project aims to investigate the strategies for potential future dynamic pricing options enabled by recent communication infrastructure solutions that tie real-time locational marginal electricity price to retail real-time pricing transmission at the interval level.

iv. Scope
- TBD

v. Deliverables
- TBD

vi. Metrics
- TBD

vii. Schedule
- TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.31 – Real-Time DER Price Signals

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - DSM

iii. Objective
   - To design and demonstrate a locational net benefit rate design structure for DERs in order to valuate DER grid services to incentivize optimal DER siting and dispatch.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.32 – System Harmonics for Power Quality Investigations

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/market design; Distribution; Transmission

iii. Objective
   - To leverage SmartMeter data to assist in identifying system harmonics that may cause power quality issues for customers.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is in planning phase.

Project #3.33 – Cyber-Physical Integrated Security

i. Investment Plan Period
  - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
  - Grid Operations/market design; Distribution; Transmission

iii. Objective
  - To demonstrate a unified security solution which matches physical access to system access to aid in the blocking of unauthorized access to PG&E's critical infrastructure.

iv. Scope
  - TBD

v. Deliverables
  - TBD

vi. Metrics
  - TBD

vii. Schedule
  - TBD

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - TBD

xi. Match Funding (if applicable)
  - TBD

xii. Match Funding Split (if applicable)
  - TBD

xiii. Funding Mechanism (if applicable)
  - TBD

xiv. Treatment of Intellectual Property (if applicable)
  - TBD

xv. Status Update
  - Project is currently on hold.

Project #3.34 – Local Wireless Security for Critical Facilities

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operations/market design; Distribution; Transmission

iii. Objective

- To develop and demonstrate a next-generation wireless security solution which would monitor airwaves around PG&E’s electric facilities to detect rogue access points installed within physically secured generation/substation facilities, which could provide bad actors access to the critical infrastructure networks.

iv. Scope

- TBD

v. Deliverables

- TBD

vi. Metrics

- TBD

vii. Schedule

- TBD

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.35 – Advance Security of Internet of Things Communications

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/market design; Distribution; Transmission

iii. Objective
   - To demonstrate an open architecture standard for secure communications between a utility and customer devices using third party communication channels (e.g., home internet connections, cellular networks, private-built field area networks).

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.36 – Cybersecurity for Industrial Control Systems (ICS)

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/market design; Transmission

iii. Objective
   - This EPIC project is proposed as a joint EPIC Administrator collaborative project that seeks to evaluate potential demonstrations that build on the foundation of machine to machine automated threat response by including adaptive controls & dynamic zoning for ICS. These would help to contain or thwart cyberattacks.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.37 – Augmented Reality

i. Investment Plan Period
  - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
  - Grid Operations/market design; Distribution

iii. Objective
  - To demonstrate technology for visualizing grid and asset data integrated with the GIS data, superimposed on a device to provide support and guidance for activities, such as asset investigations and maintenance. Augmented reality is a broad technology category which could improve the efficiency and affordability of field operations by providing faster access to key asset information during inspections and maintenance. Just as importantly, this could eventually improve field crew safety by providing hands-free information displays (e.g., through a heads-up display).

iv. Scope
  - TBD

v. Deliverables
  - TBD

vi. Metrics
  - TBD

vii. Schedule
  - TBD

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - TBD

xi. Match Funding (if applicable)
  - TBD

xii. Match Funding Split (if applicable)
  - TBD

xiii. Funding Mechanism (if applicable)
  - TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.38 – Voltage Checks

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operations/market design; Distribution

iii. Objective

- To develop and demonstrate a tool for field workers to perform remote voltage checks and identify low or no-power line situations while on-site without the need to call the central office or manually measure the line. This could potentially enable a field or dispatch employee to identify Service Points and other voltage-checkable equipment in the surrounding area, click on one of the pieces of equipment, and request the current voltage flowing through this equipment to diagnose an issue.

iv. Scope

- TBD

v. Deliverables

- TBD

vi. Metrics

- TBD

vii. Schedule

- TBD

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Project is currently on hold.

Project #3.39 – Optimized Dispatch for Restoration Events

i. Investment Plan Period
  - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
  - Transmission; Distribution

iii. Objective
  - To optimize crew movements and responses during outage dispatch to support restoration operations.

iv. Scope
  - TBD

v. Deliverables
  - TBD

vi. Metrics
  - TBD

vii. Schedule
  - TBD

viii. EPIC Funds Encumbered
  - $0

ix. EPIC Funds Spent
  - $0

x. Partners (if applicable)
  - TBD

xi. Match Funding (if applicable)
  - TBD

xii. Match Funding Split (if applicable)
  - TBD

xiii. Funding Mechanism (if applicable)
  - TBD

xiv. Treatment of Intellectual Property (if applicable)
  - TBD

xv. Status Update
  - Project is currently on hold.

Project #3.40 – Advanced Field Reference Tool

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design

iii. Objective
   - To develop a voice guided and/or free-form entry reference for field workers to ask questions and receive guidance based on PG&E's equipment libraries, safety practices, and other critical documentation.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on hold.

Project #3.41 – Drone Enablement and Operational Use

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/ market design; Distribution; Transmission

iii. Objective
   - To develop and demonstrate a foundational utility-focused Drone enablement systems and initial use cases to form the foundation for future utility Drone operations. These devices have the potential to revolutionize monitoring, inspection, and real-time awareness of pipeline and powerline infrastructure in normal or outage conditions.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update

- Project is in planning phase.

Project #3.42 – Electric Load Management for Ridesharing Electrification

i. Investment Plan Period
   - 3rd Triennial (2018-2020)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Distribution; DSM

iii. Objective
   - Evaluate grid impacts from EV charging used for ridesharing applications, to assess the ability to manage the resulting load using active demand management.

iv. Scope
   - TBD

v. Deliverables
   - TBD

vi. Metrics
   - TBD

vii. Schedule
   - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $111

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Previously defined as EPIC 2.32. Deferred to EPIC 3 by CPUC Res.E-4863 8/10/2017.
   - Project is in planning phase.

Project #3.43 – Service Issue Identification Leveraging Momentary Outage Information

i. Investment Plan Period

- 3rd Triennial (2018-2020)

ii. Assignment to Value Chain

- Grid Operations/Market Design; Distribution

iii. Objective

To test and demonstrate the hypothesis that AMI momentary events ("blinks") and trap alarms correlate to and can be used to identify specific equipment failures and/or vegetation contact. The project will use the Agile methodology to develop analytical models that use AMI momentary events and trap alarms to identify issues with customer service drops, distribution equipment, and intermittent vegetation contact.

iv. Scope

- Leverage multiple sources of data, including but not limited to SmartMeter™, time of day, location and weather data, to proactively identify potential problems in the Electric Distribution system, specifically related to identifying locations with high incidences of momentary outages which may be caused by imminent failures of conductors, insulators, transformers and/or vegetation contact.

v. Deliverables

Primary deliverables include:

- Correlation of events to geographic locations, equipment classes, and vintages, to identify areas and assets with systemic issues and/or higher likelihood of failures.
- Development of analytical models to predict & identify the equipment source of momentary events “meter blinks” and voltage sags/swells as well as momentary loss of voltage.
- Evaluation of performance of models on historical failures of assets or time frames which have been excluded from model development processes.
- Field verifications/inspections of assets identified to be responsible for smart meter anomalies to validate the models’ performance.

vi. Metrics

- 3a – Maintain / Reduce operations and maintenance costs
- 5a – Outage number, frequency and duration reductions
- 5d – Public safety improvement and hazard exposure reduction
- 7b – Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)

vii. Schedule

- 1.75 Years

viii. EPIC Funds Encumbered

- $0

ix. EPIC Funds Spent

- $0

x. Partners (if applicable)

- TBD

xi. Match Funding (if applicable)

- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Update

- Previously defined as EPIC 2.33. Deferred to EPIC 3 by CPUC Res.E-4863 8/10/2017.
- Business plan was approved in December 2019.
- Project will develop algorithms to identify patterns to predict outages by leveraging momentary outage data which may lead to an imminent failure on assets such as conductors, or insulators, transformers.
- Models will also leverage other sources of data such as time of day, location, and weather.

5. Conclusion

A. Key Results for the Year for PG&E EPIC Programs

In 2019, PG&E's EPIC Program completed one project and started four new projects.

The final EPIC 1 project, *EPIC 1.22 – Demonstrate Subtractive Billing with Submetering for EVs to Increase Customer Billing Flexibility* closed out in 2019. Through this project, PG&E identified key elements of third-party EV submetering solutions that will need to be improved before they are deployed to serve the state of California. PG&E identified that for third-party solutions to meet revenue-grade metering standards, improvements will need to be made in metering accuracy, data transfer reliability, and communication network reliability.

In 2019 PG&E launched four projects with an increased focus on safety and resiliency, that will aim to reduce wildfire risk and PSPS impact. Five additional projects are in the planning phase and are expected to launch by mid-2020.

PG&E has established and maintained strong program management practices to provide oversight of the EPIC Program and ensure the maximum value of the projects to its customer base. PG&E continues to build on its administrative best practices in response to 2017 EPIC program evaluation. Several improvements are detailed in the Utilities' joint RAP application. In addition to oversight, PG&E's EPIC Program Management Office provides:

- Communications with interested vendors and diverse suppliers through channels such as referrals and industry events (e.g., Grid Edge Executive Council, Silicon Valley Leadership Group, DistribuTECH, etc.);
- Collaboration through Industry Engagement, such as with the DOE, and other utilities;
- Coordination with the other IOUs and CEC through regularly scheduled administrator meetings and collaboration;
- Benchmarking and new technology solution vetting;
- Collaboration with research entities, such as the EPRI, CIATI& NREL;
- Administrator-coordinated execution of industry-wide EPIC workshops and symposiums;

- Other EPIC Program support, such as providing comments and/or Letters of Support to select CEC Grant Funding Opportunities (GFO); and
- Coordination with DAC.

PG&E's portfolio of EPIC projects will continue to address challenges of the changing grid landscape and the threat of climate change, including enabling an increase in DER adoption by customers, the need to modernize the grid to ensure continued safe, reliable, and resilient operation, and the need to continue improving affordability such as through advancing how to leverage data. Achievements through EPIC projects, and the future path forward for those technologies that are proven ready to scale, help pave the way for the grid of the future, advancing California policy objectives, and ultimately, improving the safety, reliability, resiliency, and affordability of the electric grid.

B. Next Steps for EPIC Investment Plan

PG&E, in conjunction with the other EPIC Administrators, will continue to host annual stakeholder workshops and symposiums, as well as workshops specifically for DAC. These industry events will focus on the sharing of progress, results, and future plans as well as understanding stakeholder needs and incorporating stakeholder input into the scoping of EPIC projects. PG&E will also continue to promote the EPIC Program through participation in both internal and external public forums and other industry events. The Utilities submitted their jointly-prepared RAP Application on April 23, 2019. Now that the Commission issued D.20-02-003 approving the RAP Application, the utilities will continue to implement the set of program enhancements proposed in their RAP application.

The CPUC established the PICG in D.18-01-008 and D.18-10-052. The PICG will help coordinate and facilitate information sharing between administrators and the CPUC. Per D.18-10-052 PG&E is responsible for administering the contract with the PICG Project Coordinator and acting as the fiscal manager on behalf of the CPUC. On December 27th, PG&E executed the PICG Coordinator contract, and PG&E looks forward to continuing to coordinate with the EPIC Administrators and CPUC through this framework.

C. Issues That May Have Major Impact on Progress in Projects

Inherent to the RD&D nature of the EPIC Program, market dynamics can change rapidly. Some potential factors that can impact the projects' progress include:

- Changes in the marketplace that may have made the project obsolete (or relatively less important to pursue);
- Different technologies have emerged that could produce better insights for the industry and PG&E customers, making some of the original proposed projects no longer the best use of available program funds;
- The technology may prove to not yet be ready for commercialization and/or not yet ready nor capable to support the later stages of the original project objective; and
- The vendor interest may drop due to the small-scale demonstration size of the project or the vendor may revise their business model such that it is no longer aligned with the projects' objectives.

Although these dynamics may impact a project's progress, it is important to keep in mind that part of the value of RD&D is in both proving what is and what is not ready to scale. While the more obvious goal of technology demonstration is to help advance pre-commercial technologies, there are cases where success may be defined as determining that a project should not proceed to full scale until additional development takes place. This avoids more costly full production deployment before a technology is ready, and also provides insight for the industry on what may need to be further developed.

PG&E mitigates some of the risk of this rapidly evolving technology landscape by managing the EPIC projects proactively. PG&E continually coordinates—both internally and externally—to stay aware of the latest technology demonstration needs, and practices enablement-focused governance over the project portfolio to help ensure successful and cost-effective technology demonstrations that emphasize continuous learning.

PACIFIC GAS AND ELECTRIC COMPANY

ATTACHMENT B

2019 EPIC ANNUAL REPORT

APPENDIX A

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
1	1st Triennial (2012-2014)	PG&E	1.01 - Energy Storage End Uses	Renewables/DER Resource Integration	• Develop technologies and strategies for efficient and optimized bidding and scheduling of Energy Storage Technologies (EST) in California Independent System Operator (CAISO) markets and demonstrate those strategies using PG&E's existing Sodium Sulfur Battery Energy Storage Systems (NaS BESS). • This project addresses the following CPUC proceedings: - As applicable, operational experiences gained from this project can inform outstanding policy and implementation issues as identified in Energy Storage Order Instituting Rulemaking 15 03 011.	• Develop and deploy technology to enable automated resource response to CAISO market awards. • Quantify the values that battery resources can capture in CAISO markets. • Establish financial performance of battery resource participation in CAISO markets.
2	1st Triennial (2012-2014)	PG&E	1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	Renewables/DER Resource Integration	• Demonstrate the ability of a utility operated energy storage asset to address capacity overloads on the distribution system and improve reliability. • This project addresses the following California Public Utilities Commission (CPUC) proceedings: - This project will count towards the Investor Owned Utility energy procurement targets as set forth in D.10 03 040, the Energy Storage Procurement Framework. - As applicable, operational experiences gained from this project can inform outstanding policy and implementation issues as identified in Energy Storage OIR R.15 03 011.	• Deploy utility operated energy storage asset at a single site. • Demonstrate peak shaving use case along with other site-specific use cases as suggested by distribution operators.

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
1	1st Triennial (2012-2014)	PG&E	1.01 - Energy Storage End Uses	• Demonstrate automated and remote control application for generic energy storage resources to interface with existing SCADA systems. • Report financial performance from participation in CAISO markets. • Report comparison of actual performance vs. hypothetical performance quoted in industry reports. • Comply with regulatory requirements and establish a framework/recommendations for accounting standards applicable to energy storage.	2.75 years	9/19/2013	No	Grid Operation/Market Design	$ 698,506	$1,660,000 - $2,030,000
2	1st Triennial (2012-2014)	PG&E	1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	• Identify energy storage site based on project objectives. • Identify an economic modeling tool to compare the planned traditional utility with alternatives using distributed resources or demand-side investments. • Construct and integrate energy storage system. • Test system and analyze results to prove project objectives.	3.5 years	7/25/2014	No	Distribution; Grid Operation/Market Design	$ 2,691,736	$3,610,000 - $4,412,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
1	1st Triennial (2012-2014)	PG&E	1.01 - Energy Storage End Uses	$ 779,833	$ 1,054,135	$ 1,833,968	$ -	Leveraged battery assets that was funded by Energy Regulators Regional Association (ERRA). Leveraged $163K, as well as software and expertise from PG&E's hydro generation group.	N/A	N/A	N/A
2	1st Triennial (2012-2014)	PG&E	1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	$ 2,764,097	$ 1,246,413	$ 4,010,510	$ -	No	N/A	No	N/A

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
1	1st Triennial (2012-2014)	PG&E	1.01 - Energy Storage End Uses	Pay for performance	N/A	Sole Source: •Power Settlements Consulting (sole vendor that could provide solution without modification or required hardware). • Trimark Associates (enhancements were made to their equipment for this EPIC project, as they were the original vendor under the capital project for the Yerba Buena and Vaca batteries).	N/A
2	1st Triennial (2012-2014)	PG&E	1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	Pay for Performance	N/A	Competitive Bid	11

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
1	1st Triennial (2012-2014)	PG&E	1.01 - Energy Storage End Uses	N/A	N/A	N/A	Yes. •Power Settlements Consulting - California-based • Trimark Associates - California-based	Column applicable to CEC only
2	1st Triennial (2012-2014)	PG&E	1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	Cupertino Electric	1	N/A	Yes - California-based.	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
1	1st Triennial (2012-2014)	PG&E	1.01 - Energy Storage End Uses	• 1i - Nameplate capacity (megawatts) of grid-connected energy storage. • 3a - Maintain/Reduce operations and maintenance costs. • 6a - CAISO NGR financial settlements. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Public Utilities Code (Pub. Util. Code) § 8360). • 7c - 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 (Pub. Util. Code § 8360). • 7l - Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services (Pub. Util. Code § 8360). • 9c - EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: CPUC R.10-12-007).	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
2	1st Triennial (2012-2014)	PG&E	1.02 - Demonstrate the Use of Distributed Energy Storage for T&D Cost Reduction	• 1c - Avoided procurement and generation costs. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Public Utilities Code (Pub. Util. Code) § 8360). • 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (Pub. Util. Code § 8360). • 9c - EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: Deferring a capacity upgrade has been identified as a key potential value of Energy Storage Technologies (ESTs) and noted in filings with the CPUC/Assembly Bill 2514.	• Project completed in February 2018 • Final Report included in this 2017 EPIC Annual Report

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
3	1st Triennial (2012-2014)	PG&E	1.03 - Demonstrate Priority Scenarios from the Energy Storage Framework	Renewables/DER Resource Integration	• The project aims to reduce existing barriers to deployment of battery energy storage systems by demonstrating whether post-electric vehicle (EV) “second life” batteries can cost-effectively perform electric distribution services. The project will demonstrate the potential for reduced energy storage system costs via a) the development of an integration platform for deploying such batteries (Phase 1) and b) the use of lower cost “second life” batteries in the integrated platform (Phase 2).	N/A
4	1st Triennial (2012-2014)	PG&E	1.04 - Expand Test Lab and Pilot Facilities for New Energy Storage Systems.	Renewables/DER Resource Integration	• This project would identify ways to enhance the existing test lab facilities at PG&E’s Applied Technology Services (ATS) center to provide lab test and pilot facilities for new energy storage systems not previously lab tested. PG&E’s ATS lab will be particularly helpful in working with the CEC and industry to test “next generation” technologies that have the potential to make breakthroughs in cost, performance targets, and other important parameters, in a test grid environment. This testing would be a critical step in accelerating commercialization of potential “game changing” technology. New types of technology that may be tested at ATS include, but are not limited to, advanced lithium devices, new sodium-based systems, zinc-air systems and new flow battery chemistries and formats. The funding required to add full capabilities to ATS is minimal. The costs to perform the tests will be paid by the industry or by entities that have received research grants from agencies such as the CEC or Department of Energy (DOE).	N/A
5	1st Triennial (2012-2014)	PG&E	1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	Renewables/DER Resource Integration	• Demonstration of emerging capabilities in mesoscale modeling to provide more granular and accurate weather forecasting input to Pacific Gas and Electric Company’s (PG&E) storm damage prediction model, and to other PG&E forecasting applications, like catastrophic wildfire risk and Photovoltaic (PV) generation. The main goal is more effective and granular damage prediction, and therefore more efficient response to storm events.	• Project focus is on development, deployment, and implementation of an operational version of the Weather Research and Forecasting (WRF) mesoscale model to support PG&E’s forecasting program related to fire, storms and solar production. • Not in scope for this project are enhancements to PG&E’s Restoration Work Plan other than improved forecast damage numbers.
6	1st Triennial (2012-2014)	PG&E	1.06 - Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility	Renewables/DER Resource Integration	• This project would demonstrate the use of accepted communications protocols to allow the California Independent System Operator (CAISO) to send an operating signal to reduce output under specified conditions, as allowed by contracts.	N/A
7	1st Triennial (2012-2014)	PG&E	1.07 - Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output	Renewables/DER Resource Integration	• There are 33 General Electric 7FA gas turbines installed in combined cycle configurations in California, which is considerably more than any other turbine model. GE offers a product marketed as “OpFlex Balance” that uses advanced controls technology to improve ramp rates to as high as 40 MW per minute (or higher in some cases). As of October 2012, none of the 7FAs in California were using this product. This project proposes to demonstrate improved ramp rate capabilities on one 7FA so that it can serve as a model for the rest of the 7FA fleet. It is assumed that there would be cost share with the vendor and the selected plant owner.	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
3	1st Triennial (2012-2014)	PG&E	1.03 - Demonstrate Priority Scenarios from the Energy Storage Framework	N/A	N/A	NA	No	Grid Operation/Market Design	$ -	$ -
4	1st Triennial (2012-2014)	PG&E	1.04 - Expand Test Lab and Pilot Facilities for New Energy Storage Systems.	N/A	N/A	NA	No	Grid operations/market design	$ -	$ -
5	1st Triennial (2012-2014)	PG&E	1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	• Fully functional mesoscale modeling system known as POMMS (PG&E Operational Mesoscale Modeling System) that will provide the following: - Detailed weather input into PG&E's damage prediction modeling system (SOPP). - Next generation wildfire threat awareness system. - Historical and forecast solar irradiance data to internal PG&E stakeholders.	3.25 years	9/19/2013	No	Distribution	$ 535,055	$720,000 - $880,000
6	1st Triennial (2012-2014)	PG&E	1.06 - Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility	N/A	N/A	NA	No	Grid Operation/Market Design	$ -	$ -
7	1st Triennial (2012-2014)	PG&E	1.07 - Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output	N/A	N/A	NA	No	Grid operations/market design	$ -	$ -

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
3	1st Triennial (2012-2014)	PG&E	1.03 - Demonstrate Priority Scenarios from the Energy Storage Framework	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
4	1st Triennial (2012-2014)	PG&E	1.04 - Expand Test Lab and Pilot Facilities for New Energy Storage Systems.	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
5	1st Triennial (2012-2014)	PG&E	1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	$ 511,681	$ 312,209	$ 823,890	$ -	N/A	N/A	N/A	N/A
6	1st Triennial (2012-2014)	PG&E	1.06 - Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
7	1st Triennial (2012-2014)	PG&E	1.07 - Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
3	1st Triennial (2012-2014)	PG&E	1.03 - Demonstrate Priority Scenarios from the Energy Storage Framework	N/A	N/A	N/A	N/A
4	1st Triennial (2012-2014)	PG&E	1.04 - Expand Test Lab and Pilot Facilities for New Energy Storage Systems.	N/A	N/A	N/A	N/A
5	1st Triennial (2012-2014)	PG&E	1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	Pay for performance	N/A	Competitive Bid & Sole Source • 1st award to create raw, gridded weather forecast data: competitive. • 2nd award to develop map of variables from data: completive. • 3rd award: Sole source to Clean Power Research due to obtain PV estimation for inclusion in solar irradiance use case.	• 1st award: 6 • 2nd award: 6
6	1st Triennial (2012-2014)	PG&E	1.06 - Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility	N/A	N/A	N/A	N/A
7	1st Triennial (2012-2014)	PG&E	1.07 - Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
3	1st Triennial (2012-2014)	PG&E	1.03 - Demonstrate Priority Scenarios from the Energy Storage Framework	N/A	N/A	N/A	N/A	N/A
4	1st Triennial (2012-2014)	PG&E	1.04 - Expand Test Lab and Pilot Facilities for New Energy Storage Systems.	N/A	N/A	N/A	N/A	Column applicable to CEC only
5	1st Triennial (2012-2014)	PG&E	1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	• 1st award: Weather Decision Technologies • 2nd award: Vertum Partners	• 1st award: 1 • 2nd award: 1	N/A	• Weather Decision Technologies: No • Vertum Partners: Yes - California-based • Clean Power Research: Yes - California-based	Column applicable to CEC only
6	1st Triennial (2012-2014)	PG&E	1.06 - Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility	N/A	N/A	N/A	N/A	N/A
7	1st Triennial (2012-2014)	PG&E	1.07 - Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
3	1st Triennial (2012-2014)	PG&E	1.03 - Demonstrate Priority Scenarios from the Energy Storage Framework	N/A	• Project not executed.
4	1st Triennial (2012-2014)	PG&E	1.04 - Expand Test Lab and Pilot Facilities for New Energy Storage Systems.	N/A	• Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.
5	1st Triennial (2012-2014)	PG&E	1.05 - Demonstrate New Resource Forecast Methods to Better Predict Variable Resource Output	• 3a - Maintain/Reduce operations and maintenance costs. • 4a - GHG emissions reductions (MMTCO2e). • 5c - Forecast accuracy improvement. • 5e - Utility worker safety improvement and hazard exposure reduction.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
6	1st Triennial (2012-2014)	PG&E	1.06 - Demonstrate Communication Systems Allowing the CAISO to Utilize Available Renewable Generation Flexibility	N/A	• Project not executed.
7	1st Triennial (2012-2014)	PG&E	1.07 - Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output	N/A	• Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
8	1st Triennial (2012-2014)	PG&E	1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	Grid Modernization and Optimization	• Develop and demonstrate a new data analytics technique to improve distribution system safety and reliability. The project specifically developed and tested a System Tool for Asset Risk (STAR), which is an enterprise software application that Electric Operations will use to calculate and display (graphically and geospatially) risk scores for electric transmission, substation and distribution assets. The STAR will enable an automated, system-wide application to improve risk identification, prioritization, and investment decisions to support electric system safety.	• Demonstrate whether the ever-increasing amounts of data can be mined and combined for targeted, cost-effective use for improved asset management. • Potential scenarios include risk-based asset management, safety hazard mitigation and proactive outage prediction using self-serve and virtual integration environments.
9	1st Triennial (2012-2014)	PG&E	1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching	Grid Modernization and Optimization	• This project explores and seeks to discover effective, new tools to safely operate "Solid Blade in Oil Rotatory Switches."	• Test new tools and techniques for safe operation of Solid Blade in Oil Rotatory Switches. • Evaluate alternatives to decrease probability of injury to workers and public. • Help design a robotic tool to allow remote operation. • Develop the necessary parts/adaptors to be used on various types (manufacturer, brand, age, etc.) of Solid Blade in Oil Rotatory Switches.
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs	Grid Modernization and Optimization	• The project focus is on development, testing, deployment, and implementation of new technologies, construction methods and techniques, and cost reduction techniques in support of the Supervisory Control and Data Acquisition (SCADA) monitoring systems used on the Distribution Networks. The monitoring system consists of a complex and extensive set of components used to assess the health and condition of the network transformers on a continuous basis. This research is looking at potential failure points on the monitoring system components and what technologies and improvements can be applied to increase life expectancy of these components and reduce production and maintenance costs for this system and similar systems.	• Assess new technologies and feasibility of application on the Distribution Networks. • Primary focus on technologies, components and work methods to extend the life expectancy of monitoring systems equipment and reduce long term maintenance costs.
11	1st Triennial (2012-2014)	PG&E	1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors	Grid Modernization and Optimization	• Gain operating experience with Discrete Series Reactors (DSR) to determine whether such devices would be cost effective and operate reliably and safely on Pacific Gas and Electric Company's (PG&E) transmission system.	• Install and test 90 DSR units on the Las Positas-Newark 230 kV line. • Install and test Server at PG&E's San Francisco General Office (SFGO) headquarters, complete with Smart Wire System Manager Software. • Communication links between the DSRs and server to support the DSR monitoring and control.

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
8	1st Triennial (2012-2014)	PG&E	1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	• Overview of existing applications and data sources. • Assessment of existing data source quality. • High-level future business processes by functional area. • Inventory of asset risk algorithms (formulas or complexity) for “In Scope” asset classes. • High-level Change Management Approach. • Prioritized and phased implementation plan. • Cost estimate for full implementation of the STAR project. • Proof of concept prototype.	2.25 years	9/19/2013	No	Transmission; Distribution	$ 1,249,505	$1,900,000 - $2,320,000
9	1st Triennial (2012-2014)	PG&E	1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching	• A working prototype for the various Solid Blade in Oil Rotatory Switch tools.	2.5 years	9/19/2013	No	Transmission; Distribution	$ 301,808	$464,000 - $567,000
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs	• Modified or improved components identified for use on Distribution Network Monitoring System. • Improved installation and construction work methods. • Economic model for maintenance variables based on life expectancy testing of components. • Changes to components.	3.25 years	9/19/2013	No	Transmission; Distribution	$ 484,250	$450,000 - $550,000
11	1st Triennial (2012-2014)	PG&E	1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors	• Installation, testing and analysis of DSR and server communication links. • Procure, construct and test the DSRs. • White paper describing project including go/no go recommendation. • Final report describing overall project, including finding from the operations and testing of DSR units and a recommendation as to whether or not to install the DSRs elsewhere in the PG&E system.	3.25 years	9/19/2013	No	Transmission	$ 1,449,835	$2,2100,00 - $2,710,000

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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
8	1st Triennial (2012-2014)	PG&E	1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	$ 1,796,618	$ 316,022	$ 2,112,640	$ -	N/A	N/A	N/A	N/A
9	1st Triennial (2012-2014)	PG&E	1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching	$ 383,991	$ 131,277	$ 515,268	$ -	N/A	N/A	N/A	N/A
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs	$ 543,414	$ 4,267	$ 547,681	$ -	N/A	N/A	N/A	N/A
11	1st Triennial (2012-2014)	PG&E	1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors	$ 1,557,351	$ 902,381	$ 2,459,732	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
8	1st Triennial (2012-2014)	PG&E	1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	Pay for performance	N/A	Competitive Bid	• 11 total bidders • 7 passed initial screen
9	1st Triennial (2012-2014)	PG&E	1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching	Pay for Performance	N/A	Competitive Bid	4
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs	Pay for performance	N/A	Competitive Bid	Phase I: 5 bids Phase 2: 8 bids
11	1st Triennial (2012-2014)	PG&E	1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors	Pay for Performance	N/A	Sole Source - Smart Wires, Inc. selected as they are the developer and sole supplier of DSR devices.	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
8	1st Triennial (2012-2014)	PG&E	1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	Space Time Insight	1	N/A	Yes - California-based	Column applicable to CEC only
9	1st Triennial (2012-2014)	PG&E	1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching	Two vendors chosen from RFP: • Inertia Switch • Trayer Issued Direct Award for Remote Solutions. They not respond to RFP, but shortly after competitive bid process completed, they announced independent creation of similar product.	The two RFP vendors tied for first.	N/A	No	Column applicable to CEC only
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs	Phase 1: Black and Veach Phase 2: Exponent	Phase 1: 1 Phase 2: 1	N/A	No	Column applicable to CEC only
11	1st Triennial (2012-2014)	PG&E	1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors	N/A	N/A	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
8	1st Triennial (2012-2014)	PG&E	1.08 - Improve Distribution System Safety and Reliability through New Data Analytics Techniques	• 7c - Dynamic optimization of grid operations and resources; including appropriate consideration for asset management and utilization of related grid operations and resource, with cost-effective full cyber security (Public Utilities Code §8360). • 3a - Maintain/Reduce operations and maintenance costs: With the improved understanding of risk, there could be a better tool for evaluating projects such as asset replacement.	• Project completed in 2015. • Final report included in previous 2015 EPIC Annual Report.
9	1st Triennial (2012-2014)	PG&E	1.09A - Test New Remote Monitoring and Control Systems for Existing Transmission & Distribution Assets: Close Proximity Switching	• 5a - Outage number, frequency and duration reductions. • 5e - Utility worker safety improvement and hazard exposure reduction.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Test New Remote Monitoring and Control Systems for T&D Assets / Demonstrate New Strategies and Technologies to Improve the Efficacy of Existing Maintenance and Replacement Programs	• 3a - Maintain/Reduce operations and maintenance costs. • 3b - Maintain/Reduce capital costs. • 5d - Public safety improvement and hazard exposure reduction. • 5e - Utility worker safety improvement and hazard exposure reduction.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
11	1st Triennial (2012-2014)	PG&E	1.09C - Test New Remote Monitoring and Control Systems for T&D Assets: Discrete Series Reactors	• 3a - Maintain/Reduce operations and maintenance costs. • 3b - Maintain/Reduce capital costs. • 5a - Outage number, frequency and duration reductions. • 5b - Electric system power flow congestion reduction.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
12	1st Triennial (2012-2014)	PG&E	1.10A - Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis	Grid Modernization and Optimization	• Develop tools and algorithms that analyze data from monitoring equipment installed on substation equipment (distribution and transmission) that tests for dissolved gasses or other precursor data that would assist in understanding the condition of the equipment.	N/A
13	1st Triennial (2012-2014)	PG&E	1.10C - Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis	Grid Modernization and Optimization	• Develop tools and algorithms that analyze load and operating characteristic data from underground cables in order to develop an understanding of potential failure points, cable maintenance needs, and cable life expectancy.	N/A
14	1st Triennial (2012-2014)	PG&E	1.11 - Demonstrate Self-Correcting Tools to Improve System Records and Operations	Grid Modernization and Optimization	• Demonstrate tools that identify and “register” existing assets to improve the integration between utility planning and operations. As part of the demonstration, implement “self-correcting” technologies that identifies plan vs. actual discrepancies and updates system records automatically. High priority use cases include: (1) Mapping of transformers to primary phase; (2) Mapping of customers to transformers; and (3) Precision mapping of Pacific Gas and Electric Company’s overhead and underground network.	N/A
15	1st Triennial (2012-2014)	PG&E	1.12 - Demonstrate New Technologies that Improve Wildlife Safety and Protect Assets from Weather-Related Degradation	Grid Modernization and Optimization	• Demonstrate new strategies and technologies to improve animal and bird protection, reduce outages caused by animals and birds, and protect assets from expensive weather related degradation such as fog related corrosion.	N/A
16	1st Triennial (2012-2014)	PG&E	1.13 - Demonstrate New Communication Systems to Improve Substation Automation and Interoperability	Grid Modernization and Optimization	• Demonstrate new strategies and technologies to convert and integrate multiple existing proprietary technologies within the substation environment for more effective operations. Substation are key operational hubs and represent significant investments, which must be further leveraged by engaging with vendors to create the next generation of interoperable substation services and products.	N/A
17	1st Triennial (2012-2014)	PG&E	1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	Grid Modernization and Optimization	• This project explores and discovers effective new network applications and devices to leverage and improve the SmartMeter™ communications network.	• Leverage the existing SmartMeter™ network to support additional applications. Inform future uses of the SmartMeter™ network such as message capability, security, latency, and engineering constraints. Specifically focus on: - Test new devices to support network functions and capabilities not previously envisioned (e.g., new data streams, faster data collection). - Evaluate alternatives to decrease future upgrade, maintenance and/or operational costs. - Demonstrate different network applications, each focused on separate use cases.

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Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
12	1st Triennial (2012-2014)	PG&E	1.10A - Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis	N/A	N/A	NA	No	Transmission; Distribution	$ -	$ -
13	1st Triennial (2012-2014)	PG&E	1.10C - Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis	N/A	N/A	NA	No	Distribution	$ -	$ -
14	1st Triennial (2012-2014)	PG&E	1.11 - Demonstrate Self-Correcting Tools to Improve System Records and Operations	N/A	N/A	NA	No	Transmission; Distribution	$ -	$ -
15	1st Triennial (2012-2014)	PG&E	1.12 - Demonstrate New Technologies that Improve Wildlife Safety and Protect Assets from Weather-Related Degradation	N/A	N/A	NA	No	Transmission; Distribution	$ -	$ -
16	1st Triennial (2012-2014)	PG&E	1.13 - Demonstrate New Communication Systems to Improve Substation Automation and Interoperability	N/A	N/A	NA	No	Transmission; Distribution	$ -	$ -
17	1st Triennial (2012-2014)	PG&E	1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	• Evaluate new applications and devices, their associated data traffic impact on the SmartMeter™ network, and recommend which items warrant consideration for full scale deployment. • Develop business case based on findings for full deployment consideration.	3.25years	9/19/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$ 3,986,281	$3,780,000 - $4,550,000

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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
12	1st Triennial (2012-2014)	PG&E	1.10A - Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
13	1st Triennial (2012-2014)	PG&E	1.10C - Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
14	1st Triennial (2012-2014)	PG&E	1.11 - Demonstrate Self-Correcting Tools to Improve System Records and Operations	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
15	1st Triennial (2012-2014)	PG&E	1.12 - Demonstrate New Technologies that Improve Wildlife Safety and Protect Assets from Weather-Related Degradation	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
16	1st Triennial (2012-2014)	PG&E	1.13 - Demonstrate New Communication Systems to Improve Substation Automation and Interoperability	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
17	1st Triennial (2012-2014)	PG&E	1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	$ 3,325,881	$ 809,376	$ 4,135,257	$ -	No	N/A	N/A	N/A

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	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
12	1st Triennial (2012-2014)	PG&E	1.10A - Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis	N/A	N/A	N/A	N/A
13	1st Triennial (2012-2014)	PG&E	1.10C - Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis	N/A	N/A	N/A	N/A
14	1st Triennial (2012-2014)	PG&E	1.11 - Demonstrate Self-Correcting Tools to Improve System Records and Operations	N/A	N/A	N/A	N/A
15	1st Triennial (2012-2014)	PG&E	1.12 - Demonstrate New Technologies that Improve Wildlife Safety and Protect Assets from Weather-Related Degradation	N/A	N/A	N/A	N/A
16	1st Triennial (2012-2014)	PG&E	1.13 - Demonstrate New Communication Systems to Improve Substation Automation and Interoperability	N/A	N/A	N/A	N/A
17	1st Triennial (2012-2014)	PG&E	1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	Pay for Performance	• Provisional patent filed for Smart Pole Meter and Meter Socket • Full patent filed for development of Wire Down Algorithm.	Sole Source - Silver Springs Network selected as they solutions provider for PG&E's AMI electric network. It is necessary to work with SSN to ensure that devices and applications can communicate across the AMI network.	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
12	1st Triennial (2012-2014)	PG&E	1.10A - Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis	N/A	N/A	N/A	N/A	N/A
13	1st Triennial (2012-2014)	PG&E	1.10C - Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis	N/A	N/A	N/A	N/A	N/A
14	1st Triennial (2012-2014)	PG&E	1.11 - Demonstrate Self-Correcting Tools to Improve System Records and Operations	N/A	N/A	N/A	N/A	N/A
15	1st Triennial (2012-2014)	PG&E	1.12 - Demonstrate New Technologies that Improve Wildlife Safety and Protect Assets from Weather-Related Degradation	N/A	N/A	N/A	N/A	N/A
16	1st Triennial (2012-2014)	PG&E	1.13 - Demonstrate New Communication Systems to Improve Substation Automation and Interoperability	N/A	N/A	N/A	N/A	N/A
17	1st Triennial (2012-2014)	PG&E	1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	N/A	N/A	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
12	1st Triennial (2012-2014)	PG&E	1.10A - Demonstrate Automated Asset Notification and Management Systems: Dissolved Gas Analysis	N/A	• Project not executed.
13	1st Triennial (2012-2014)	PG&E	1.10C - Demonstrate Automated Asset Notification and Management Systems: Underground Cable Analysis	N/A	• Project not executed.
14	1st Triennial (2012-2014)	PG&E	1.11 - Demonstrate Self-Correcting Tools to Improve System Records and Operations	N/A	• Project not executed.
15	1st Triennial (2012-2014)	PG&E	1.12 - Demonstrate New Technologies that Improve Wildlife Safety and Protect Assets from Weather-Related Degradation	N/A	• Project not executed.
16	1st Triennial (2012-2014)	PG&E	1.13 - Demonstrate New Communication Systems to Improve Substation Automation and Interoperability	N/A	• Project not executed.
17	1st Triennial (2012-2014)	PG&E	1.14 - Demonstrate "Next Generation" SmartMeter™ Telecom Network Functionalities (includes 1.14.17 Smart Pole Meter)	• 7f - Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation (Public Utilities Code (Pub. Util. Code) §8360). • 7k - Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid (Pub. Util. Code §8360). • Note: Each technology demonstrated may have additional specific benefits to name. For instance, the following could apply: improved communication for power restoration, improved control of streetlights, etc.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
18	1st Triennial (2012-2014)	PG&E	1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future	Grid Modernization and Optimization	• The objective of this pilot is to develop and pilot a real-time data visualization software platform for use by Electric Distribution Operations end users. Data will be integrated from various data sources and displayed on Distribution Control Center video walls and individual desktop computers, with potential for future scalability to handheld devices.	• Scope includes the integration of data (network model, loading, SmartMeter™ devices, outages, weather, etc.) and a real-time data visualization platform for Distribution Operations. • The Distribution Management System (DMS) platform and predictive analytics are not included in the scope.
19	1st Triennial (2012-2014)	PG&E	1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	Grid Modernization and Optimization	• Leverage plug-in hybrid vehicle technology emerging in Pacific Gas and Electric Company (PG&E) fleet to generate utility-grade power, supporting distribution circuits during planned or unplanned outage events.	• Develop nominally 120 kilowatt exportable power capabilities from a plug in hybrid electric truck. Seek to create the protocols necessary to safely connect the truck to the appropriate grid connection points. The portfolio of fleet vehicles (higher and lower weight classes) may broaden the range of available power ratings demonstrated by the project.
20	1st Triennial (2012-2014)	PG&E	1.17 - Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI	Grid Modernization and Optimization	• PG&E can leverage EPIC dollars by participating and collaborating in multi-utility industry-wide research initiatives conducted by third party organizations experienced in the RD&D area. These programs would allow PG&E to cost effectively develop a deeper awareness of industry trends, access real world experience through pilot programs, and identify the gaps that utilities will fill or close with technology. For example, through participation in existing EPRI programs, PG&E would participate in and gain access to demonstrations, analyses, and results of the testing and study of distribution equipment and strategies. High Value EPRI programs include: IntelliGrid, Integration of Distributed Renewables, Energy Storage, Risk Mitigation Strategies, and Distribution Grid Modernization programs.	N/A
21	1st Triennial (2012-2014)	PG&E	1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information	Customer Service and Enablement	• This project focuses on delivering the cost by major appliances to customers.	• This project will use the data enabled by the SmartMeter™ platform to provide appliance level itemization of monthly bill charges to customers, without their completing any audit or subscribing to any new service. This project assumes that minute level meter data is available.

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
18	1st Triennial (2012-2014)	PG&E	1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future	• Demonstrate Real-time Data Visualization Platform, including data integration from a variety of data sources and a visual interface that includes geospatial, list, and trending layers.	3.25 years	9/19/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$ 1,334,030	$3,780,000 - $4,620,000
19	1st Triennial (2012-2014)	PG&E	1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	• Develop operating requirements for the vehicle. • Understand engineering challenges with high power export with collaborative supplier development to solve. • Develop safety and interconnection protocols to connect the vehicle to the grid leveraging existing protocols for temporary local generator set connection. • Define and document power requirements for different outage/usage scenarios. • Develop operating protocols (when and how the vehicles will be used). • Develop unplanned outage protocols. • Develop the hardware and software (if required) to connect the vehicle to PG&E's system. • Build vehicles for field testing.	3.25 years	9/19/2013	No	Distribution	$ 643,840	$3,600,000 - $4,400,000
20	1st Triennial (2012-2014)	PG&E	1.17 - Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI	N/A	N/A	NA	No	Transmission; Distribution	$ -	$ -
21	1st Triennial (2012-2014)	PG&E	1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information	• Quantify disaggregation accuracy and compare vendors. • Based on results, provide recommendations for deployment strategy of appliance level billing.	2.5years	9/19/2013	No	Demand-Side Management	$ 1,399,248	$1,080,000 - $1,320,000

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
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(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
18	1st Triennial (2012-2014)	PG&E	1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future	$ 1,605,622	$ 2,527,552	$ 4,133,173	$ -	N/A	N/A	N/A	N/A
19	1st Triennial (2012-2014)	PG&E	1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	$ 2,488,160	$ 1,521,628	$ 4,009,788	$ 125	Department of Energy (DOE) provided test services using National Renewable Energy Lab (NREL) facilities. Approximate cost share to date: $120,000.	DOE/NREL; Edison Electric Institute engaged for elec. utility industry staging events; Portland General Electric closely collaborating for industry-level requirements	N/A	N/A
20	1st Triennial (2012-2014)	PG&E	1.17 - Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
21	1st Triennial (2012-2014)	PG&E	1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information	$ 1,231,202	$ 65,640	$ 1,296,842	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
18	1st Triennial (2012-2014)	PG&E	1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future	Pay For Performance	New Intellectual Property (IP) has been created through co-development with the vendor. PG&E retains ownership rights to the IP and will provide free unlimited use rights to CA IOUs per the CPUC decision	Competitive Bid	3
19	1st Triennial (2012-2014)	PG&E	1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	Pay for performance	N/A	• Phase 1 (Mule Phase): 2 Direct Awards - Efficient Drivetrains, Inc. (EDI) and Electric Vehicle International (EVI) selected due to short-term availability of prototype driveline and capability of generating utility-grade export power on F550 - diesel/gasoline configuration • Phase 2 (Alpha Phase): Based on results of Mule phase, moved forward with EDI, which was designed to help formulate specs for Phase 3 • Phase 3 (Beta Phase): Competitive solicitation. 10 potential bidders. Received 2 final bids.	2 (Phase 3 - Beta Phase)
20	1st Triennial (2012-2014)	PG&E	1.17 - Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI	N/A	N/A	N/A	N/A
21	1st Triennial (2012-2014)	PG&E	1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information	Pay for performance	N/A	Sole Source - Silver Springs Network, as they are the solutions provider for PG&E's AMI electric network. It is necessary to work with SSN to ensure that devices and applications can communicate across the AMI network.	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
18	1st Triennial (2012-2014)	PG&E	1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future	BitStew	1	N/A	No	Column applicable to CEC only
19	1st Triennial (2012-2014)	PG&E	1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	Efficient Drivetrains, Inc. (EDI) (Phase 3 - Beta Phase)	1 (Phase 3 - Beta Phase)	N/A	N/A	Column applicable to CEC only
20	1st Triennial (2012-2014)	PG&E	1.17 - Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI	N/A	N/A	N/A	N/A	N/A
21	1st Triennial (2012-2014)	PG&E	1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information	N/A	N/A	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
18	1st Triennial (2012-2014)	PG&E	1.15 - Demonstrate New Technologies and Strategies That Support Integrated "Customer-to-Market-to-Grid" Operations of the Future	• 5a - Outage number, frequency and duration reductions. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Public Utilities Code 8360). • 3a - Maintain/Reduce operations and maintenance costs.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
19	1st Triennial (2012-2014)	PG&E	1.16 - Demonstrate Electric Vehicle as a Resource to Improve Grid Power Quality and Reduce Customer Outages	• 5a - Outage number, frequency and duration reductions. • 5e - Utility worker safety improvement and hazard exposure reduction. • 3a - Maintain/Reduce operations and maintenance costs. • 4a – Greenhouse Gas emissions reductions (MMTCO2e).	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
20	1st Triennial (2012-2014)	PG&E	1.17 - Leverage EPIC Funds by Participating in Multi-Utility, Industry Wide RD&D Programs Such as EPRI	N/A	• Project not executed.
21	1st Triennial (2012-2014)	PG&E	1.18 - Demonstrate SmartMeter™-Enabled Data Analytics to Provide Customers With Appliance-Level Energy Use Information	• 1f - Avoided customer energy use. • 1h - Customer bill savings (dollars saved).	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
22	1st Triennial (2012-2014)	PG&E	1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	Customer Service and Enablement	• The project is to explore and discover effective, new data that can be collected and studied for further benefits. Demonstrate the type of additional data that can be collected and/or processed through the SmartMeter™ platform. Evaluate impact of any increased data traffic on the SmartMeter™ network. Focus on new data collection that makes the SmartMeter™ platform more robust for more customers.	• Demonstrate the collection of new data from SmartMeter™ devices. Example use cases include: - Power Quality Data (C12.19 format). - New Data Channels. - Mobile data collection methods. - Power theft detection methodology using SmartMeter™ data for revenue assurance purposes.
23	1st Triennial (2012-2014)	PG&E	1.20 - Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation.	Customer Service and Enablement	• This project will fund continued support of Green Button Connect (GBC). GBC provides a small number of vendors in the competitive market with automated access to recurring, machine-to-machine, programmatic data access to customer-authorized SmartMeter™ data in order to develop new, innovative and creative ways for customers to manage their energy consumption. GBC is a small demonstration, not scalable to support the larger customer base and wider vendor audience. PG&E is planning on implementing a robust, broader scale offering as part of its Customer Data Access (CDA) project.	N/A
24	1st Triennial (2012-2014)	PG&E	1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	Customer Service and Enablement	• This project aims to validate and integrate a software platform to identify photovoltaic (PV) resources by leveraging Smart Meter™ data. This project focuses on addressing the issue of unauthorized interconnections in an automated fashion by developing and algorithm to identify resources, including integration with Pacific Gas and Electric Company (PG&E) billing and interconnection database, as well as develop an automated outreach system for identified customers. • This project addresses California Public Utilities Commission proceeding, R.11 09 011 Rule 21 to support the improved distribution level interconnection rules and regulations for certain classes of electric generators and electric storage resources.	• Identify vendor to develop or pilot software. • Develop integration and communication platform for auto identification of Unauthorized Interconnections (UI). • Demonstrate ability to automatically integrate software with billing and interconnection.

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
22	1st Triennial (2012-2014)	PG&E	1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	• Evaluate new data and analytic methodologies, their associated impact on the SmartMeter™. • Recommendation of which data warrants consideration for full-scale deployment. • Evaluation should provide key inputs to a business case for general deployment.	3.25 years	9/19/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$ 1,051,786	$1,780,000 - $2,180,000
23	1st Triennial (2012-2014)	PG&E	1.20 - Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation.	N/A	N/A	NA	No	Demand-Side Management	$ -	$ -
24	1st Triennial (2012-2014)	PG&E	1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	• Successful integration of software with PG&E's Customer Care and Billing (CC&B) system. • Successful tracking of all UIs identified. • Successful tracking of communication and "conversion" of UIs to interconnection.	2.5years	5/1/2014	No	Distribution; Demand-Side Management	$ 868,495	$1,200,000 - $1,460,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
22	1st Triennial (2012-2014)	PG&E	1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	$ 841,884	$ 1,138,615	$ 1,980,499	$ -	Leveraging existing AMI network investments.	N/A	N/A	N/A
23	1st Triennial (2012-2014)	PG&E	1.20 - Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation.	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
24	1st Triennial (2012-2014)	PG&E	1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	$ 902,652	$ 435,173	$ 1,337,825	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
22	1st Triennial (2012-2014)	PG&E	1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	Pay for Performance	N/A	Competitive Bid	3
23	1st Triennial (2012-2014)	PG&E	1.20 - Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation.	N/A	N/A	N/A	N/A
24	1st Triennial (2012-2014)	PG&E	1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	Pay for performance	Patent No. 10,557,720 Unauthorized Electrical Grid Connection Detection and Characterization System and Resource Mapping Server and System will be granted on February 11, 2020.	Sole Source - Nexant selected due to expertise in PG&E's CC&B database, PV generation data analysis and AMI network.	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
22	1st Triennial (2012-2014)	PG&E	1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	BitStew & Primestone	Tie for first	N/A	No	Column applicable to CEC only
23	1st Triennial (2012-2014)	PG&E	1.20 - Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation.	N/A	N/A	N/A	N/A	Column applicable to CEC only
24	1st Triennial (2012-2014)	PG&E	1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	N/A	N/A	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
22	1st Triennial (2012-2014)	PG&E	1.19 - Pilot Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	• 1h - Customer bill savings (dollars saved). • 1f - Avoided customer energy use (kilowatt-hours saved). • 3a - Maintain/Reduce operations and maintenance costs. • 3b - Maintain/Reduce capital costs. • 5d - Public safety improvement and hazard exposure reduction. • 5e - Utility worker safety improvement and hazard exposure reduction. • 5f - Reduced flicker and other power quality differences. • 5i. Increase in the number of nodes in the power system at monitoring points. • 7f - Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
23	1st Triennial (2012-2014)	PG&E	1.20 - Demonstrate the Benefits of Providing the Competitive, Open Market With Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation.	N/A	• Formally notified CPUC on 10-31-13, project may be terminated as refined scope does not appear to meet safety, reliability, affordability guiding principles for priority Research and Development.
24	1st Triennial (2012-2014)	PG&E	1.21 - Pilot Methods for Automatic Identification of Distributed Energy Resources (Such as Solar PV) as They Interconnect to the Grid to Improve Safety & Reliability	• 5d - Public safety improvement and hazard exposure reduction. • 5f - Reduced flicker and other power quality differences. • 5c - Forecast accuracy improvement.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
25	1st Triennial (2012-2014)	PG&E	1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	Customer Service and Enablement	• EV submetering pilot to test subtractive metering process and Electric Vehicle Service Provider (EVSP) business models. • This project addresses CPUC D.13-11-008, which requires Pacific Gas and Electric Company (PG&E), along with the other two California Investor Owned Utilities (IOU), to pursue a submetering pilot and eventual protocol.	• Electric Vehicle (EV) submetering pilot will entail EV Meter Data Management Agents (MDMA) delivering submeter data to IOU for subtraction from customer's primary meter to create an EV and a house bill. Customer will be responsible for both bills. In Phase 2, an additional business model will be introduced where the MDMA will be responsible for the bill to PG&E.
26	1st Triennial (2012-2014)	PG&E	1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	Customer Service and Enablement	• Initiative to obtain additional un-netted Photovoltaic (PV) data to support customer call center bill experience, and provide additional service to its customers. PV generation data will be integrated with existing MyEnergy web portal for customers' benefit. • This project addresses California Public Utilities Commission proceeding, Net Energy Metering R.12-11-005 and R.11 09 011 Rule 21.	• Explore four different methods for obtaining PV generation data (Dedicated SmartMeter™, submeter communication via ZigBee radio, third party estimates, and data exchange with solar companies, and work with vendor to relay data to customer.
27	1st Triennial (2012-2014)	PG&E	1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	Customer Service and Enablement	• Assess how to best utilize DSM resources to create a targeted customer- and location-specific approach to assist with distribution capacity constraints. • This project addresses California Public Utilities Commission proceeding, Distribution Resources Planning R.14 08 013, through improving efficiencies between interconnection and integration.	• Improve ability to estimate Heating, Ventilation and Air Conditioning (HVAC) Direct Load Control (DLC) load impacts at the distribution feeder level to aid in better understanding of the localized impact of HVAC DLC devices on meeting distribution feeder level reliability concerns.
28	1st Triennial (2012-2014)	PG&E	1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	Customer Service and Enablement	• Develop, pilot, and validate approaches that help determine the optimal location of DC fast chargers based on traffic patterns and distribution grid infrastructure.	• Acquire travel pattern data and grid infrastructure capability data to identify low cost, high utilization areas in which to integrate DC fast chargers into Pacific Gas and Electric Company's (PG&E) distribution system.

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
25	1st Triennial (2012-2014)	PG&E	1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	• Process to receive MDMA submetered data. • Process to subtract EV data from primary meter to create two bills. • Inclusion of EV portion of bill on customer's monthly bill. • Process for billing MDMA for participant submeter charges. • Obtain third party evaluator for both phases of pilot through a Request for Proposal (RFP). • Incentive payments to MDMA.	5years	11/14/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$ 2,756,187	$1,730,000 - $2,120,000
26	1st Triennial (2012-2014)	PG&E	1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	• Implement pilot program for dedicated smart meters and third party estimates. • Explore opportunities for submetering technology and solar company data exchange. • Modify existing Customer Data Warehouse (CDW)/MyEnergy interface to allow for additional data streams and visualization. • Evaluate relative merits of various generation measurement/estimation approaches.	2.5 years	5/1/2014	No	Grid Ops and Mkt. Design / Distribution / DSM	$ 950,313	$1,200,000 - $1,460,000
27	1st Triennial (2012-2014)	PG&E	1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	• Deploy data logging devices on a scientific sample of existing SmartAC™ Cycling customers, to enable real time monitoring of device performance and load impacts at feeder level. • Develop infrastructure to make real-time data available on feeder-level load impacts of SmartAC™ Cycling to distribution operations. • Produce report describing a case study methodology of targeting and valuing customer side peak load reductions at the feeder level.	2 years	5/1/2014	No	Transmission; Distribution; Grid Operation/Market Design; Demand-Side Management	$ 1,206,477	$1,327,000 - $1,621,000
28	1st Triennial (2012-2014)	PG&E	1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	• Develop a process to identify optimal DC fast charging sites. • Develop a map that presents the locations of optimal DC fast charging sites in a meaningful manner to customers.	2.5 years	5/1/2014	No	Distribution; Demand-Side Management	$ 391,425	$400,000 - $490,000

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	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
25	1st Triennial (2012-2014)	PG&E	1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	$ 2,042,779	$ 256,299	$ 2,299,078	$ -	N/A	N/A	N/A	N/A
26	1st Triennial (2012-2014)	PG&E	1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	$ 873,453	$ 450,363	$ 1,323,817	$ -	N/A	N/A	N/A	N/A
27	1st Triennial (2012-2014)	PG&E	1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	$ 1,262,770	$ 77,583	$ 1,340,353	$ -	N/A	N/A	N/A	N/A
28	1st Triennial (2012-2014)	PG&E	1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	$ 308,232	$ 132,537	$ 440,769	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
25	1st Triennial (2012-2014)	PG&E	1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	Pay for Performance	N/A	Competitive Bid	15
26	1st Triennial (2012-2014)	PG&E	1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	Pay for performance	N/A	• Sole Source - - Opower - PG&E's customer facing web portal, My Energy. Given the project is integrated PV generation interval data into My Energy, it was necessary to work with them. - Clean Power Research - Purchased subscription to estimated generation data.	N/A
27	1st Triennial (2012-2014)	PG&E	1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	Pay for performance	N/A	Sole sourced - Enetics is a consulting firm that performed a study that assessed the available technologies that would best address the need of the project and determined Enetics provides that solution. They were also willing to make enhancements to their device to further meet the need of PG&E and were the lowest cost and immediately available.	N/A
28	1st Triennial (2012-2014)	PG&E	1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	Pay for Performance	N/A	Competitive Bid	4

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
25	1st Triennial (2012-2014)	PG&E	1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	Nexant, Inc.	1	N/A	No	Column applicable to CEC only
26	1st Triennial (2012-2014)	PG&E	1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	N/A	N/A	N/A	Opower - No Clean Power Research - Yes: California-based	Column applicable to CEC only
27	1st Triennial (2012-2014)	PG&E	1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	N/A	N/A	N/A	No	Column applicable to CEC only
28	1st Triennial (2012-2014)	PG&E	1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	Energy and Environmental Economics, Inc. (E3)	1	N/A - E3 was the highest scoring vendor.	Yes - California-based, small business, and Minority Based Enterprise (MBE).	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	*B*	*C*	*AC*	*AD*
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
25	1st Triennial (2012-2014)	PG&E	1.22 - Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility	• 4a - GHG emissions reductions (MMTCO2e). • 1h - Customer bill savings (megawatt hours saved).	• Project compeleted in 2019. • Final Report is included in 2019 EPIC Annual Report.
26	1st Triennial (2012-2014)	PG&E	1.23 - Demonstrate Additive Billing With Submetering for PVs to Increase Customer Billing Flexibility	• 5c - Forecast accuracy improvements. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Public Utilities Code 8360).	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
27	1st Triennial (2012-2014)	PG&E	1.24 - Demonstrate Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	• 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Public Utilities Code 8360).	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.
28	1st Triennial (2012-2014)	PG&E	1.25 - Develop a Tool to Map The Preferred Locations for DC Fast Charging, Based on Traffic Patterns and PG&E's Distribution System, to Address EV Drivers' Needs While Reducing the Impact on PG&E's Distribution Grid	• 3a - Maintain/Reduce capital costs. • 3d - Number of operations of various existing equipment types before and after adoption of a new smart grid component, as an indicator of possible equipment life extensions from reduced wear and tear. • 4a - Greenhouse Gas emissions reductions (MMTCO2e). • 5c - Forecast accuracy improvement. • 5d - Public safety improvement and hazard exposure reduction. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Public Utilities Code § 8360). • 7l - Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.	• Project completed in 2016. • Final Report was included in 2016 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
29	1st Triennial (2012-2014)	PG&E	1.26 - Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources into the CAISO Wholesale Market	Customer Service and Enablement	• Develop, demonstrate and validate approaches and technologies that enable the cost effective integration (specifically, the measurement and telemetry) of mass market DR resources into the California Independent System Operator (CAISO) wholesale market. While other DR projects focus on integration of DR resources into various utility and future Independent System Operator operational needs, this project intends to test alternative telemetry solutions and technologies to satisfy CAISO operational visibility requirements.	N/A
30	2nd Triennial (2015-2017)	PG&E	2.01 - Evaluate Storage on the Distribution Grid	Renewables/DER Resource Integration	• Identify and evaluate whether system needs can be cost-effectively addressed with energy storage, including identifying a range of storage deployment locations and grid interconnection requirements on a granular level.	N/A
31	2nd Triennial (2015-2017)	PG&E	2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	Renewables/DER Resource Integration	Demonstrate new technology to monitor and control Distributed Energy Resources (DER) to manage system constraints and evaluate the potential value of DER flexibility to the grid. The DERMS pilot will drive learning about the people, process, and technology needed to operate the high DER penetration grid of 2025. • Define boundaries and integrations with other PG&E and external systems such as Demand Response Management System (DRMS), Advanced Distribution Management System (ADMS) and CAISO market systems among others. • Enable informed choice for long-term strategic vendor in 2017+ (demonstration is not choosing the long term vendor). • Identify limitations of existing as-built models and field telemetry data • Evaluate the performance of aggregated DERs providing distribution services • Create, test, and iterate on future DERMS requirements (e.g., communication requirements for PG&E and third party owned DERs). • Learn about business process change and personnel skills & knowledge needed to implement DERMS. • This project informs California Public Utilities Commission proceeding, Distribution Resources Plan R.14 08 013 to inform distribution planning by demonstrating DER integration into planning and operations.	• Demonstrate minimum viable DERMS operation at Pacific Gas and Electric Company (PG&E) to address key DER management use cases. • The demonstration will take place in a limited geography with a diverse set of DERs being monitored and controlled by the DERMS demonstration.

APPENDIX A
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Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
29	1st Triennial (2012-2014)	PG&E	1.26 - Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources into the CAISO Wholesale Market	N/A	N/A	NA	No	Grid Operation/Market Design and Demand-side Management.	$ -	$ -
30	2nd Triennial (2015-2017)	PG&E	2.01 - Evaluate Storage on the Distribution Grid	N/A	N/A	NA	No	Grid Operations/Market Design; Transmission; Distribution; DSM	$ -	$ -
31	2nd Triennial (2015-2017)	PG&E	2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	• The functional integration of a DERMS software minimum viable product and operational demonstration of the identified use cases. • A report that: - Determines the most important characteristics of a full deployment solution including detailed functional and technical requirements. - Identifies best practices and required internal capabilities for a full deployment solution. - Develops operational processes that can be scaled to a wider system deployment. - Defines boundaries and integrations with other PG&E systems (e.g., DRMS, DMS, market systems). - Develops a point of view on the utility role in managing DERs for grid and economic benefits.	2.75years	9/15/2015	No	Grid Operation/Market Design	$ 2,535,324	$6,000,000 - $7,320,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
29	1st Triennial (2012-2014)	PG&E	1.26 - Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources into the CAISO Wholesale Market	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
30	2nd Triennial (2015-2017)	PG&E	2.01 - Evaluate Storage on the Distribution Grid	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
31	2nd Triennial (2015-2017)	PG&E	2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	$ 3,065,566	$ 3,729,818	$ 6,795,385	$ 18,437	N/A	N/A	$419,000	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
29	1st Triennial (2012-2014)	PG&E	1.26 - Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources into the CAISO Wholesale Market	N/A	N/A	N/A	N/A
30	2nd Triennial (2015-2017)	PG&E	2.01 - Evaluate Storage on the Distribution Grid	N/A	N/A	N/A	N/A
31	2nd Triennial (2015-2017)	PG&E	2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	Pay for performance	N/A	Competitive Bid	5

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
29	1st Triennial (2012-2014)	PG&E	1.26 - Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources into the CAISO Wholesale Market	N/A	N/A	N/A	N/A	N/A
30	2nd Triennial (2015-2017)	PG&E	2.01 - Evaluate Storage on the Distribution Grid	N/A	N/A	N/A	N/A	Column applicable to CEC only
31	2nd Triennial (2015-2017)	PG&E	2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	GE Alstom	1	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
29	1st Triennial (2012-2014)	PG&E	1.26 - Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources into the CAISO Wholesale Market	N/A	• Project not executed.
30	2nd Triennial (2015-2017)	PG&E	2.01 - Evaluate Storage on the Distribution Grid	N/A	• Project not executed.
31	2nd Triennial (2015-2017)	PG&E	2.02 - Pilot Distributed Energy Resource Management Systems (DERMS)	• 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Public Utilities Code (Pub. Util. Code) § 8360). • 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (Pub. Util. Code § 8360).	• Project completed in January 2019 • The project provided an opportunity for PG&E to define and deploy a DERMS and supporting technology to uncover barriers and specify requirements to prepare for the increasing challenges and opportunities of DERs at scale. The DERMS Demo was a field demonstration of optimal control of a portfolio of 3rd party aggregated behind-the-meter (BTM) solar and energy storage and utility front-of-the-meter (FTM) energy storage to provide distribution capacity and voltage support services while also allowing for participation of these same DERs in the CAISO wholesale market. • Additionally, the DERMS Demo explored the ability to manage DERs that participate in wholesale markets to also provide distribution and customer services to enable DER value stacking, often referred to as multiple use applications (MUA). • Final Report included in 2018 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
32	2nd Triennial (2015-2017)	PG&E	2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	Renewables/DER Resource Integration	• This project will explore the use and impact of aggregated customer-sited smart inverters to help inform emerging industry standards, as well as define the operational and communication requirements to support the advancement and deployment of new inverter technologies. • This project addresses California Public Utilities Commission proceeding, Distribution Resources Plan R.14 08 013, by informing Distributed Energy Resources modeling by incorporating Smart Inverters. The findings of this report will also support and inform PG&E's position within the Rule 21 open proceeding.	• Evaluate the technical ability of Smart Inverters to influence secondary and primary voltage through field demonstrations in two distinct locations, by adjusting reactive and real power output autonomously. • Measure customer curtailment from Volt-VAR/Volt-Watt function activation. • Demonstrate and evaluate the reliability of communications to provide visibility, monitoring and change settings for Smart Inverter-equipped PV using both a vendor-specific aggregation platform and a vendor-agnostic utility aggregation platform. • Clarify SI technology requirements to integrate and operate SIs, and characterize challenges to deployment at scale relative to today. • Through lab testing, understand Smart Inverter performance under a range of distribution grid conditions. • Through a vendor-led modeling effort, evaluate the impact of BTM residential PV and PV + Storage with and without Smart Inverters and perform an economic analysis of SIs on PG&E's system as compared to traditional distribution grid upgrades.
33	2nd Triennial (2015-2017)	PG&E	2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	Renewables/DER Resource Integration	• Assessment of the use and impact of EV energy flow capabilities as a complement to the smart inverter assessment related to Photovoltaics (PV) in project 2.03A. Smart Inverters for PV	• Technology demonstration for charging and discharging of the Electric Vehicle (EV) in response to demand response or hard islanding events. • Testing multiple test modes. • Technology assessment from customer and ratepayer perspectives through a customer survey and a cost-benefit evaluation.

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Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
32	2nd Triennial (2015-2017)	PG&E	2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	• Identify feeder(s) where Smart Inverters will be installed for demonstration. • Demonstrate the use of residential and commercial Smart Inverters on multiple distribution feeders to demonstrate the inverters' local voltage control capabilities and power quality impacts related to high penetration of customer sited solar PV. • Develop necessary communications software/hardware/technologies between the utility and two different third party Smart Inverter aggregators. • Design and implement data architectures to support satellite and cellular interaction with remote Smart Inverters. • Quantify and qualify performance of multiple Smart Inverter models from different manufacturers in lab testing. • Implement automated Volt-VAR and Volt-Watt curves, with a quantification of ability to perform different grid services. • Lab-test electric vehicle service equipment (EVSE) performance under a large range of harmonic content, to identify any chance of poor behavior. • Through a modeling effort, provide an economic assessment of Smart Inverter functions' effectiveness in deferring certain distribution upgrades associated with high Distributed Energy Resource (DER) penetration.	3.5years	4/10/2015	No	Distribution; Demand-Side Management	$ 2,879,961	$4,767,300 - $5,826,700
33	2nd Triennial (2015-2017)	PG&E	2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	• Evaluation of the performance of the EV energy flow capabilities to support residential load during DR and hard islanding events. • Cost-benefit evaluation	2years	1/8/2016	No	Distribution; Demand-Side Management	$ 225,158	$414,000 - $506,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
32	2nd Triennial (2015-2017)	PG&E	2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	$ 2,430,138	$ 2,543,838	$ 4,973,977	$30,737	This project is leveraging funds from the PG&E Smart Grid Volt/Var Optimization (VVO) pilot given they are completing the testing of the functionality of the smart inverter technologies. The results of the testing will impact this project's opportunity to launch.	N/A	N/A	N/A
33	2nd Triennial (2015-2017)	PG&E	2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	$ 260,177	$ 273,936	$ 534,113	$ 13,506	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
32	2nd Triennial (2015-2017)	PG&E	2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	Pay for Performance	N/A	Sole Source - SolarCity selected due to their large residential market share and large amount of customers on impacted distribution circuits that is most relevant to test their technologies.	N/A
33	2nd Triennial (2015-2017)	PG&E	2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	Pay for Performance	N/A	Quick Bid	4

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
32	2nd Triennial (2015-2017)	PG&E	2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	N/A	N/A	N/A	N/A	Column applicable to CEC only
33	2nd Triennial (2015-2017)	PG&E	2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	Navigant	1	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	**i. Investment Plan Period**		**Project Name**	**vi. Metrics**	**xv. 2019 Status Update**
32	2nd Triennial (2015-2017)	PG&E	2.03A - Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	• 3a – Maintain/Reduce operations and maintenance costs. • 3b - Maintain / Reduce capital costs. • 3e – Non-energy economic benefits • 5f – Reduced flicker and other power quality differences • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360) • 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360)	• Project completed in February 2019. • This project demonstrated the functionality and grid impacts of Smart Inverters (SI) through a field demonstration, a lab testing, and modeling. • The field demonstration targeted high voltage issues attributed to high PV penetration as well as an evaluation of a vendor-agnostic aggregation platform that allowed for the remote management of SI-enabled PV assets. • The demonstration also used PG&E laboratory facilities to evaluate the ability of multiple vendors' SI products to execute Rule 21 SI functions and employed the Electric Power Research Institute (EPRI) to model SI performance and economic analysis on simulated PG&E distribution feeders. • Final Report included in 2018 EPIC Annual Report.
33	2nd Triennial (2015-2017)	PG&E	2.03B - Test Smart Inverter Enhanced Capabilities - Vehicle to Home	• 3a - Maintain/Reduce operations and maintenance costs. • 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources.	• Project completed in Februaray 2018 • The project demonstrated that a bi-directional EV and charger can support critical household loads through an outage. However, the project also determined that, in addition to the technology not being commercially available, it is not cost effective for customers to adopt. This was supported by the project's customer survey results which indicate the current cost estimate is roughly 4 times higher than an optimal price for consumers. Therefore, even though the project use cases were technically proven-- they are not currently feasible due to technology cost, limited market value, and other restrictions between actors (e.g. EV battery warranty coverage). • Final Report included in 2017 EPIC Annual Report

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
34	2nd Triennial (2015-2017)	PG&E	2.04 - DG Monitoring & Voltage Tracking	Renewables/DER Resource Integration	• Utilization of the voltage measurement capabilities of SmartMeter™ devices to monitor Distributed Generation (DG) output and identify voltage fluctuations caused by the intermittent nature of distributed renewable resources. • Use of data analytics techniques and Advanced Metering Infrastructure (AMI) (and other) data to determine the impact of PV penetration on Rule 2 violations and • Create a rating for the probability that a Rule 2 violation is caused by DG.	• Create an algorithmic process output rating on the likelihood of a voltage violation (on a given transformer) being caused by DG fluctuations.
35	2nd Triennial (2015-2017)	PG&E	2.05 - Inertia Response Emulation for DG Impact Improvement	Renewables/DER Resource Integration	• Demonstrate the capability to emulate inertia injection and support primary frequency control using energy storage and smart inverter technologies to potentially mitigate the impacts of large-scale Distributed Generation (DG) to the grid, improve the grid performance and reliability, and advance California energy policy to increase the amounts of renewable and distributed generation on the grid.	• Develop computer models to evaluate inverter capabilities and demonstrate possible future system needs for new inertia support solutions. • Analyze and optimize the present technology's energy storage inertial response capabilities via Power-Hardware-In-Loop testing.

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Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
34	2nd Triennial (2015-2017)	PG&E	2.04 - DG Monitoring & Voltage Tracking	• Develop an analytics process/algorithm to analyze AMI and other data for high penetration DG feeders, as well as some low penetration feeders for baselining. • Evaluate impact of DG penetration on voltage.	2years	4/10/2015	No	Grid Operations/Market Design	$ 741,202	$1,110,000 - $1,360,000
35	2nd Triennial (2015-2017)	PG&E	2.05 - Inertia Response Emulation for DG Impact Improvement	• Evaluation of the power system's need for reliability support, including identifying threshold conditions. • Assessment of the capabilities of present energy storage inverters for inertial frequency response functions. • Provide recommendations for future inverter and interconnection requirements to provide inertial response.	2years	1/6/2017	No	Grid Operations/ Market Design; Transmission	$ 589,375	$1,450,000 - $1,780,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	*B*	*C*	*K*	*L*	*M*	*N*	*O*	*P*	*Q*	*R*
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
34	2nd Triennial (2015-2017)	PG&E	2.04 - DG Monitoring & Voltage Tracking	$ 818,830	$ 414,463	$ 1,233,293	$ 7,583	N/A	N/A	N/A	N/A
35	2nd Triennial (2015-2017)	PG&E	2.05 - Inertia Response Emulation for DG Impact Improvement	$ 587,426	$ 810,601	$ 1,398,027	$15,981	N/A	National Renewable Energy Laboratory selected as testing and demonstration provider.	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	**i. Investment Plan Period**		**Project Name**	**xiii. Funding Mechanism (if applicable)**	**xiv. Treatment of Intellectual Property (if applicable)**		
34	2nd Triennial (2015-2017)	PG&E	2.04 - DG Monitoring & Voltage Tracking	Pay for Performance	N/A	Competitive Bid	12
35	2nd Triennial (2015-2017)	PG&E	2.05 - Inertia Response Emulation for DG Impact Improvement	Pay for performance	N/A	Quick Bid	4

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ELECTRIC PROGRAM INVESTMENT CHARGE
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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
34	2nd Triennial (2015-2017)	PG&E	2.04 - DG Monitoring & Voltage Tracking	Nexant, Inc.	1	N/A	No	Column applicable to CEC only
35	2nd Triennial (2015-2017)	PG&E	2.05 - Inertia Response Emulation for DG Impact Improvement	NREL	1	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
34	2nd Triennial (2015-2017)	PG&E	2.04 - DG Monitoring & Voltage Tracking	• 3a - Maintain/Reduce operations and maintenance costs. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Public Utilities Code 8360). • 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources.	•• Project completed in 2017. • This project demonstrated an algorithmic process for analyzing new data sources (including SmartMeter™ devices and databases of solar irradiance) to predict the likelihood that a Rule 2 voltage violation was caused by distributed solar generation. Solar energy is by nature intermittent, and ebbs and surges of generation can change the voltage for neighboring, downstream customers. This functionality, if integrated into a larger grid analytics platform, might improve decision making for power quality engineers responding to customer issues. • Final Report included in 2017 EPIC Annual Report.
35	2nd Triennial (2015-2017)	PG&E	2.05 - Inertia Response Emulation for DG Impact Improvement	• 1a. Number and total nameplate capacity of distributed generation facilities • 1b. Total electricity deliveries from grid-connected distributed generation facilities • 1i. Nameplate capacity (MW) of grid-connected energy storage • 3e. Non-energy economic benefits (reliability) • 5a. Outage number, frequency and duration reductions • 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360) • 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360) • 7h. 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 (PU Code § 8360)	• Project completed in February 2019. • This project explored the capabilities of inverter-based energy resources to provide a set of functions related to system inertia which support the electric system. • The project demonstrated via transmission system modeling and Power-Hardware-In-Loop testing that advanced inverter control methods can provide active power support that improves the system's frequency response in the face of reduced conventional inertia from synchronous machine generators. • Inverter control methods were explored including inertia-like response (derivative control) and grid-forming (voltage source) modes for respective benefits in bulk system and isolated distribution system use cases. • Final Report included in 2018 EPIC Annual Report.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
36	2nd Triennial (2015-2017)	PG&E	2.06 - Intelligent Universal Transformer (IUT)	Renewables/DER Resource Integration	• Develop and demonstrate a solid-state transformer field prototype Medium Voltage Fast Charger (MVFC) system, as an application use case of solid-state transformers for Direct Current (Direct Current) fast charging of Plug In Electric Vehicles (PEV), featuring intelligent controls and multiple fast charging of PEVs.	• Test demonstration and communication to the same DC solid-state transformer with two protocols.
37	2nd Triennial (2015-2017)	PG&E	2.07 - Real-Time Loading Data for Distribution Operations and Planning	Grid Modernization and Optimization	• This demonstration will leverage interval data to improve feeder modeling, inform near real time load allocation throughout the distribution grid and transformer loading profiles, and identify opportunities to enhance current load forecasting processes for distribution transformers, feeders and substation transformers.	• Utilize AMI and other data sources to develop an algorithm to improve the prediction of grid loading. • Demonstrate the aggregation of this loading up through the distribution model to enhance distribution planning as well as real time distribution grid operations.
38	2nd Triennial (2015-2017)	PG&E	2.08 - "Smart" Monitoring and Analysis Tools	Grid Modernization and Optimization	• Demonstrate strategies and technologies for real time, online monitoring of substation equipment; Demonstrate communication protocols and equipment to support the smart devices; Develop visualization techniques for improved monitoring; and evaluate new vendor technologies that enable data correlation and predictive analysis to better identify and respond to potential safety, reliability and/or operational issues.	N/A
39	2nd Triennial (2015-2017)	PG&E	2.09 - Distributed Series Impedance (DSI) Phase 2	Grid Modernization and Optimization	• Demonstrate congestion mitigation by installing DSIs on parallel transmission facilities to demonstrate the next generation of the Distributed Series Reactor (DSR) devices from the First EPIC Triennial Plan, which may allow for better control of transmission line loading.	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
36	2nd Triennial (2015-2017)	PG&E	2.06 - Intelligent Universal Transformer (IUT)	• Develop a proof of concept that may demonstrate: 1. an Intelligent Universal Transformer (IUT) can be used in lieu of other equipment to connect to Direct Current Fast Charge (DCFC) protocols, and 2. an IUT can communicate back to the utility.	2.25years	9/15/2015	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$ -	$ -
37	2nd Triennial (2015-2017)	PG&E	2.07 - Real-Time Loading Data for Distribution Operations and Planning	• Develop a unique loading algorithm and rubrics for determining cost effective data sources and cadences.	3.5 years	4/10/2015	No	Grid Operation/Market Design; Distribution	$ 1,822,317	$2,420,000 - $2,958,000
38	2nd Triennial (2015-2017)	PG&E	2.08 - "Smart" Monitoring and Analysis Tools	N/A	N/A	N/A	No	Transmission	$ -	$ -
39	2nd Triennial (2015-2017)	PG&E	2.09 - Distributed Series Impedance (DSI) Phase 2	N/A	N/A	N/A	No	Transmission	$ -	$ -

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
36	2nd Triennial (2015-2017)	PG&E	2.06 - Intelligent Universal Transformer (IUT)	$ -	$ -	$ -	$0	N/A	N/A	N/A	N/A
37	2nd Triennial (2015-2017)	PG&E	2.07 - Real-Time Loading Data for Distribution Operations and Planning	$ 1,621,152	$ 928,884	$ 2,550,035	$ 10,592	N/A	N/A	N/A	N/A
38	2nd Triennial (2015-2017)	PG&E	2.08 - "Smart" Monitoring and Analysis Tools	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
39	2nd Triennial (2015-2017)	PG&E	2.09 - Distributed Series Impedance (DSI) Phase 2	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
36	2nd Triennial (2015-2017)	PG&E	2.06 - Intelligent Universal Transformer (IUT)	N/A	N/A	N/A	N/A
37	2nd Triennial (2015-2017)	PG&E	2.07 - Real-Time Loading Data for Distribution Operations and Planning	Pay for Performance	N/A	Competitive Bid	12
38	2nd Triennial (2015-2017)	PG&E	2.08 - "Smart" Monitoring and Analysis Tools	N/A	N/A	N/A	N/A
39	2nd Triennial (2015-2017)	PG&E	2.09 - Distributed Series Impedance (DSI) Phase 2	N/A	N/A	N/A	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
36	2nd Triennial (2015-2017)	PG&E	2.06 - Intelligent Universal Transformer (IUT)	N/A	TBD	TBD	N/A	Column applicable to CEC only
37	2nd Triennial (2015-2017)	PG&E	2.07 - Real-Time Loading Data for Distribution Operations and Planning	Trove Predictive Data	1	N/A	No	Column applicable to CEC only
38	2nd Triennial (2015-2017)	PG&E	2.08 - "Smart" Monitoring and Analysis Tools	N/A	N/A	N/A	N/A	Column applicable to CEC only
39	2nd Triennial (2015-2017)	PG&E	2.09 - Distributed Series Impedance (DSI) Phase 2	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
36	2nd Triennial (2015-2017)	PG&E	2.06 - Intelligent Universal Transformer (IUT)	• 3a - Maintain/Reduce operations and maintenance costs. • 3b - Maintain/Reduce capital costs. • 5d - Public safety improvement and hazard exposure reduction. • 7k - Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid. • 7l - Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.	• Project put on hold after determining the product (IUT) was not mature enough for a technology demonstration through EPIC.
37	2nd Triennial (2015-2017)	PG&E	2.07 - Real-Time Loading Data for Distribution Operations and Planning	• 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.	• Project completed in December 2018 • This project developed analytical methods for generating near real-time load forecast information. The project successfully built and demonstrated a platform to ingest and process SmartMeter™, Supervisory Control and Data Acquisition (SCADA), photovoltaic system (PV) generation, Geographic Information System (GIS) and weather data for two of the eight Areas of Responsibility (AOR) within PG&E's service territory. • Final Report included in 2018 EPIC Annual Report.
38	2nd Triennial (2015-2017)	PG&E	2.08 - "Smart" Monitoring and Analysis Tools	N/A	• Project not executed.
39	2nd Triennial (2015-2017)	PG&E	2.09 - Distributed Series Impedance (DSI) Phase 2	N/A	• Project not executed.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
40	2nd Triennial (2015-2017)	PG&E	2.10 - Emergency Preparedness Modeling	Grid Modernization and Optimization	• Incorporate natural hazard damage model information into one integrated algorithm/tool, which would provide the ability to quickly estimate the impacts of natural hazards on Pacific Gas and Electric Company facilities to enable faster response and restoration. • Provide the ability to prepare for these hazards by proactively modeling the impacts of potential hazards, to understand system vulnerabilities and restoration resource requirements. • Incorporate work optimization algorithms to more efficiently allocate crews. • Utilize artificial intelligence and statistical methods to model productive rates and automatically develop restoration plans.	• Develop optimization algorithms and visualization tool that includes asset locations and conditions with multiple potential hazards, which allows for the aggregation of equipment damage estimates (via damage models, outage information systems, and damage assessments), est. hours to repair, and recommended allocation of work resources to efficiently respond to a natural hazard.
41	2nd Triennial (2015-2017)	PG&E	2.11 - New Mobile Technology & Visualization Applications	Grid Modernization and Optimization	• Demonstrate tailored, advanced mobile applications for Pacific Gas and Electric Company field operations that build upon Grid Operations Situational Intelligence (Project #15) demonstration projects in the EPIC First Triennial Plan as well as existing “baseline” mobile deployments underway.	N/A
42	2nd Triennial (2015-2017)	PG&E	2.12 - New Emergency Management Mobile Applications	Grid Modernization and Optimization	• Develop new mobile applications to enhance Pacific Gas and Electric Company’s emergency preparedness and response capabilities.	N/A
43	2nd Triennial (2015-2017)	PG&E	2.13 - Digital Substation/Substation Automation	Grid Modernization and Optimization	• Investigate and evaluate sustainable protection and control technologies for future “digital” substations, which may include testing technologies in a lab setting, and performing a pilot implementation to demonstrate technology adoption and integration with legacy substation protection and control technologies.	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
40	2nd Triennial (2015-2017)	PG&E	2.10 - Emergency Preparedness Modeling	• Complete algorithms that aggregate data from multiple sources to feed into application. • Incorporate multiple algorithms into a proof of concept visualization tool. • Develop recommendation for deployment strategy.	3.5years	4/10/2015	No	Transmission; Distribution	$ 2,713,522	$3,993,000 - $4,881,000
41	2nd Triennial (2015-2017)	PG&E	2.11 - New Mobile Technology & Visualization Applications	N/A	N/A	N/A	No	Distribution	$ -	$ -
42	2nd Triennial (2015-2017)	PG&E	2.12 - New Emergency Management Mobile Applications	N/A	N/A	N/A	No	Transmission; Distribution	$ -	$ -
43	2nd Triennial (2015-2017)	PG&E	2.13 - Digital Substation/Substation Automation	N/A	N/A	N/A	No	Transmission; Distribution	$ -	$ -

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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	*B*	*C*	*K*	*L*	*M*	*N*	*O*	*P*	*Q*	*R*
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
40	2nd Triennial (2015-2017)	PG&E	2.10 - Emergency Preparedness Modeling	$ 2,872,630	$ 1,354,498	$ 4,227,128	$ 1,538	N/A	N/A	N/A	N/A
41	2nd Triennial (2015-2017)	PG&E	2.11 - New Mobile Technology & Visualization Applications	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
42	2nd Triennial (2015-2017)	PG&E	2.12 - New Emergency Management Mobile Applications	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
43	2nd Triennial (2015-2017)	PG&E	2.13 - Digital Substation/Substation Automation	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
40	2nd Triennial (2015-2017)	PG&E	2.10 - Emergency Preparedness Modeling	Pay for Performance	PG&E will receive perpetual, transferable sublicenses to all Work Product to use for current and future PG&E business.	Competitive Bid	3
41	2nd Triennial (2015-2017)	PG&E	2.11 - New Mobile Technology & Visualization Applications	N/A	N/A	N/A	N/A
42	2nd Triennial (2015-2017)	PG&E	2.12 - New Emergency Management Mobile Applications	N/A	N/A	N/A	N/A
43	2nd Triennial (2015-2017)	PG&E	2.13 - Digital Substation/Substation Automation	N/A	N/A	N/A	N/A

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ELECTRIC PROGRAM INVESTMENT CHARGE
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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
40	2nd Triennial (2015-2017)	PG&E	2.10 - Emergency Preparedness Modeling	IBM	1	N/A	No	Column applicable to CEC only
41	2nd Triennial (2015-2017)	PG&E	2.11 - New Mobile Technology & Visualization Applications	N/A	N/A	N/A	N/A	Column applicable to CEC only
42	2nd Triennial (2015-2017)	PG&E	2.12 - New Emergency Management Mobile Applications	N/A	N/A	N/A	N/A	Column applicable to CEC only
43	2nd Triennial (2015-2017)	PG&E	2.13 - Digital Substation/Substation Automation	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
40	2nd Triennial (2015-2017)	PG&E	2.10 - Emergency Preparedness Modeling	• 3a - Maintain/Reduce operations and maintenance costs. • 4a - Greenhouse Gas emissions reductions (MMTCO2e). • 5a - Outage number, frequency and duration reductions. • 5d - Public safety improvement and hazard exposure reduction. • 5e - Utility worker safety improvement and hazard exposure reduction. • 5c - Forecast accuracy improvement.	• Project completed in February 2019. • This project developed the Restoration Work Plan (RWP) system to demonstrate rapid and accurate restoration plan development for emergencies • The project demonstrated the ability to aggregate equipment damage estimates via damage models, assessments, and outage information systems. • It also was able to determine time needed for restoration and optimal work resources through a machine learning performance model that predicts accurate work demand and resource performance. • A mixed integer linear programming (MILP) optimization model that considered multiple stochastic damage scenarios was built to provide resource positioning recommendations that are fast and transparent and more cost-effective and efficient. • Final Report included in 2018 EPIC Annual Report.
41	2nd Triennial (2015-2017)	PG&E	2.11 - New Mobile Technology & Visualization Applications	N/A	• Project not executed.
42	2nd Triennial (2015-2017)	PG&E	2.12 - New Emergency Management Mobile Applications	N/A	• Project not executed.
43	2nd Triennial (2015-2017)	PG&E	2.13 - Digital Substation/Substation Automation	N/A	• Project not executed.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
44	2nd Triennial (2015-2017)	PG&E	2.14 - Automatically Map Phasing Information	Grid Modernization and Optimization	• This project aims to explore a variety of pre-commercial analytics and/or hardware options to automatically map 3-phase electrical power information in order to improve the distribution network models.	• Project seeks to improve distribution network models through automatic mapping of 3 phase electrical power information.
45	2nd Triennial (2015-2017)	PG&E	2.15 - Synchrophasor Applications for Generator Dynamic Model Validation	Grid Modernization and Optimization	• This project will demonstrate new synchrophasor analysis applications that can perform generator dynamic model parameter estimation and validation using disturbance data recorded by the synchrophasor system. New synchrophasor applications could perform mandated generator model validation without requiring time and labor intensive on-site tests, and could detect subsynchronous resonance and other conditions which can cause generator outages.	• Scope is limited to confirming that analysis of Phasor Measurement Unit (PMU) data is better than costly on-site model validation in the target geography. Scope does not include widespread deployment of PMUs.
46	2nd Triennial (2015-2017)	PG&E	2.16 - Enhanced Synchrophasor Analytics & Applications	Grid Modernization and Optimization	• Demonstrate new techniques to synthesize Synchrophasor data and utilize the data for advanced real-time system applications, such as wide-area monitoring, protection, and control systems, which could help move Synchrophasor applications beyond planning, forensics, and visualization to enhanced wide-area monitoring, protection, and control applications.	N/A
47	2nd Triennial (2015-2017)	PG&E	2.17 - Geomagnetic Disturbance (GMD) Evaluation	Grid Modernization and Optimization	• Evaluate system vulnerability to GMD by modeling GMD that occurs during a geomagnetic storm and evaluating the impact on transmission lines, interconnection lines, substations and system voltages.	N/A
48	2nd Triennial (2015-2017)	PG&E	2.18 - Optical Instrument Transformers and Sensors for Protection and Control Systems	Grid Modernization and Optimization	• Demonstrate newer technologies, such as optical sensors, as well as strategies and technologies to configure appropriate protection settings, including the coordination required between both new and conventional instrumentation.	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
44	2nd Triennial (2015-2017)	PG&E	2.14 - Automatically Map Phasing Information	• Develop algorithm or novel process to use AMI data and other sources to determine the assignment of Phases to conducting components.	2.75 years	9/15/2015	No	Distribution; Demand-Side Management	$ 1,566,518	$1,660,000 - $2,030,000
45	2nd Triennial (2015-2017)	PG&E	2.15 - Synchrophasor Applications for Generator Dynamic Model Validation	• Install synchrophasors (or “PMUs”) on generators or generator tie-lines, and demonstrate new data analysis software applications. • Evaluate the applications’ ability to perform generator dynamic model validation by analyzing synchrophasor data following transient disturbances on the transmission system.	3 years	4/10/2015	No	Transmission	$ 620,157	$654,000 - $799,000
46	2nd Triennial (2015-2017)	PG&E	2.16 - Enhanced Synchrophasor Analytics & Applications	N/A	N/A	N/A	No	Transmission	$ -	$ -
47	2nd Triennial (2015-2017)	PG&E	2.17 - Geomagnetic Disturbance (GMD) Evaluation	N/A	N/A	N/A	No	Transmission	$ -	$ -
48	2nd Triennial (2015-2017)	PG&E	2.18 - Optical Instrument Transformers and Sensors for Protection and Control Systems	N/A	N/A	N/A	No	Transmission	$ -	$ -

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
44	2nd Triennial (2015-2017)	PG&E	2.14 - Automatically Map Phasing Information	$ 1,505,937	$ 431,407	$ 1,937,344	$ 17,575	N/A	PG&E is working with University of California, Riverside to test an alternate algorithm based approach which will be evaluated against other solutions demonstrated in project	N/A	N/A
45	2nd Triennial (2015-2017)	PG&E	2.15 - Synchrophasor Applications for Generator Dynamic Model Validation	$ 567,444	$ 172,504	$ 739,948	$ 1,022	N/A	N/A	N/A	N/A
46	2nd Triennial (2015-2017)	PG&E	2.16 - Enhanced Synchrophasor Analytics & Applications	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
47	2nd Triennial (2015-2017)	PG&E	2.17 - Geomagnetic Disturbance (GMD) Evaluation	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
48	2nd Triennial (2015-2017)	PG&E	2.18 - Optical Instrument Transformers and Sensors for Protection and Control Systems	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
44	2nd Triennial (2015-2017)	PG&E	2.14 - Automatically Map Phasing Information	Pay for performance	N/A	• Sole Source - - Silver Springs Network selected as they are the solutions provider for PG&E's AMI electric network. It is necessary to work with SSN to ensure that devices and applications can communicate across the AMI network. - Navigant selected due to industry expertise and familiarity with PG&E-specific systems - Consulting branch of UC Riverside selected per industry expertise	N/A
45	2nd Triennial (2015-2017)	PG&E	2.15 - Synchrophasor Applications for Generator Dynamic Model Validation	Pay for performance	N/A	• Sole Source - - MathWorks was selected as the software tool because they are the only commercial vendor of this type of parameter estimation tool required for the project. - Schweitzer Engineering Labs was selected as the PMU vendor because they are the only vendor to offer a module to measure generator rotor angle which was necessary for the modeling effort.	N/A
46	2nd Triennial (2015-2017)	PG&E	2.16 - Enhanced Synchrophasor Analytics & Applications	N/A	N/A	N/A	N/A
47	2nd Triennial (2015-2017)	PG&E	2.17 - Geomagnetic Disturbance (GMD) Evaluation	N/A	N/A	N/A	N/A
48	2nd Triennial (2015-2017)	PG&E	2.18 - Optical Instrument Transformers and Sensors for Protection and Control Systems	N/A	N/A	N/A	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	B	C	W	X	Y	AA	AB
For Report DOC	i. Investment Plan Period		Project Name					
44	2nd Triennial (2015-2017)	PG&E	2.14 - Automatically Map Phasing Information	N/A	N/A	N/A	N/A	Column applicable to CEC only
45	2nd Triennial (2015-2017)	PG&E	2.15 - Synchrophasor Applications for Generator Dynamic Model Validation	N/A	N/A	N/A	No	Column applicable to CEC only
46	2nd Triennial (2015-2017)	PG&E	2.16 - Enhanced Synchrophasor Analytics & Applications	N/A	N/A	N/A	N/A	Column applicable to CEC only
47	2nd Triennial (2015-2017)	PG&E	2.17 - Geomagnetic Disturbance (GMD) Evaluation	N/A	N/A	N/A	N/A	Column applicable to CEC only
48	2nd Triennial (2015-2017)	PG&E	2.18 - Optical Instrument Transformers and Sensors for Protection and Control Systems	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
44	2nd Triennial (2015-2017)	PG&E	2.14 - Automatically Map Phasing Information	• 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid.	• Project completed in December 2018 • This project successfully developed and demonstrated automated analytical methods for determining meter phasing and meter-to-transformer connectivity using SmartMeter™, Supervisory Control and Data Acquisition (SCADA) and Geographic Information System (GIS) data. • The in-house method developed by PG&E delivered promising results and PG&E is currently working towards further improving the performance of the algorithms, so that an automated solution may be implemented at scale. • Final Report included in 2018 EPIC Annual Report
45	2nd Triennial (2015-2017)	PG&E	2.15 - Synchrophasor Applications for Generator Dynamic Model Validation	• 3a - Maintain/Reduce operations and maintenance costs. • 5a - Outage number, frequency and duration reductions. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (Public Utilities Code 8360).	• Project completed in December 2018. • The integration of PMUs on generators for dynamic model validation is a new technology and the project did not result in a tool that is production ready. As applications evolve, installation of PMUs at generating stations could potentially allow utilities to enhance their generator model validation processes. • Final Report included in 2018 EPIC Annual Report.
46	2nd Triennial (2015-2017)	PG&E	2.16 - Enhanced Synchrophasor Analytics & Applications	N/A	• Project not executed.
47	2nd Triennial (2015-2017)	PG&E	2.17 - Geomagnetic Disturbance (GMD) Evaluation	N/A	• Project not executed.
48	2nd Triennial (2015-2017)	PG&E	2.18 - Optical Instrument Transformers and Sensors for Protection and Control Systems	N/A	• Project not executed.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
49	2nd Triennial (2015-2017)	PG&E	2.19 - Enable Distributed Demand-Side Strategies & Technologies	Customer Service and Enablement	• Demonstrate distributed energy storage and approaches to address local and flexible resource needs. • This project addresses California Public Utilities Commission proceeding, Distribution Resources Plan R.14 08 013, by demonstrating DER locational benefits and addressing capacity constraints through aggregated behind the meter (BTM) customer energy storage.	• Deploy an aggregation of BTM customer energy storage resource to reduce peak loading or absorb distributed generation on a utility distribution feeder(s).
50	2nd Triennial (2015-2017)	PG&E	2.20 - Real-Time Energy Usage Feedback to Customers	Customer Service and Enablement	• Evaluate innovative feedback technologies to provide near real-time energy usage information to customers and to drive greater customer performance during DR events.	N/A
51	2nd Triennial (2015-2017)	PG&E	2.21 - Home Area Network (HAN) for Commercial Customers	Customer Service and Enablement	• This project will demonstrate the application of HAN technology to Pacific Gas and Electric Company's commercial customers.	• This project will enable the Zigbee HAN radio on Large Commercial and Industrial (LCI) meters, to facilitate LCI customer access to real time usage data, as well as testing of the integration with existing Energy Management Systems (EMS).

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
49	2nd Triennial (2015-2017)	PG&E	2.19 - Enable Distributed Demand-Side Strategies & Technologies	• Demonstrate and test field results for effectiveness of the use of aggregated customer-sited BTM energy storage resources to peak load reduction and/or absorb distributed generation on a utility distribution feeder(s). • Demonstrate communications with aggregated resources for visualization and control. • Evaluate cost-effectiveness and reliability of BTM energy storage for addressing capacity constraints.	2.75 years	4/10/2015	No	Distribution; Demand-Side Management	$ 1,678,045	$2,615,000 - $3,197,000
50	2nd Triennial (2015-2017)	PG&E	2.20 - Real-Time Energy Usage Feedback to Customers	N/A	N/A	N/A	No	Grid Operations/ Market Design; Distribution; Demand-Side Management	$ -	$ -
51	2nd Triennial (2015-2017)	PG&E	2.21 - Home Area Network (HAN) for Commercial Customers	• Install Zigbee HAN devices with selected LCI customers and connect devices to their SmartMeter™. • Monitor customer usage and issue/collect customer surveys. • Complete report with identified issues and recommendations for how to integrate with an existing EMS.	2.25years	9/15/2015	No	Demand-Side Management	$ 8,451	$180,000 - $220,000

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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
49	2nd Triennial (2015-2017)	PG&E	2.19 - Enable Distributed Demand-Side Strategies & Technologies	$ 1,471,957	$ 710,092	$ 2,182,049	$ 31,151	N/A	N/A	N/A	N/A
50	2nd Triennial (2015-2017)	PG&E	2.20 - Real-Time Energy Usage Feedback to Customers	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
51	2nd Triennial (2015-2017)	PG&E	2.21 - Home Area Network (HAN) for Commercial Customers	$ 22,302	$ 201,174	$ 223,476	$ 3,193	N/A	Rainforest Automation providing development of the cloud service application used by the customers	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
49	2nd Triennial (2015-2017)	PG&E	2.19 - Enable Distributed Demand-Side Strategies & Technologies	Pay for Performance	N/A	Competitive Bid	10
50	2nd Triennial (2015-2017)	PG&E	2.20 - Real-Time Energy Usage Feedback to Customers	N/A	N/A	N/A	N/A
51	2nd Triennial (2015-2017)	PG&E	2.21 - Home Area Network (HAN) for Commercial Customers	Pay for Performance	N/A - No current evidence of Intellectual Property development	Sole Source to Rainforest Automation for purchase of energy monitoring devices that connect to the SmartMeter™.	N/A

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(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
49	2nd Triennial (2015-2017)	PG&E	2.19 - Enable Distributed Demand-Side Strategies & Technologies	Solar City (for residential customers); Green Charge Networks (for commercial customers)	1	N/A	No	Column applicable to CEC only
50	2nd Triennial (2015-2017)	PG&E	2.20 - Real-Time Energy Usage Feedback to Customers	N/A	N/A	N/A	N/A	Column applicable to CEC only
51	2nd Triennial (2015-2017)	PG&E	2.21 - Home Area Network (HAN) for Commercial Customers	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
49	2nd Triennial (2015-2017)	PG&E	2.19 - Enable Distributed Demand-Side Strategies & Technologies	• 1c - Avoided procurement and generation costs. • 1i - Nameplate Capacity of Grid-Connected Storage. • 3f - Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management. • 5b - Electric system power flow congestion reduction. • 5d - Public safety improvement and hazard exposure reduction. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid. • 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources.	• Project completed in February 2018 • Final Report included in 2017 EPIC Annual Report
50	2nd Triennial (2015-2017)	PG&E	2.20 - Real-Time Energy Usage Feedback to Customers	N/A	• Project not executed.
51	2nd Triennial (2015-2017)	PG&E	2.21 - Home Area Network (HAN) for Commercial Customers	• 1e - Peak load reduction (megawatts) from summer and winter programs. • 1f - Avoided customer energy use (kilowatt hours saved). • 1h - Customer bill savings (dollars saved). • 3a - Maintain / Reduce operations and maintenance costs. • 4a - GHG emissions reductions (MMTCO2e). • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Public Utilities Code § 8360).	• Project completed in February 2018 • Final Report included in 2017 EPIC Annual Report

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
52	2nd Triennial (2015-2017)	PG&E	2.22 - Demand Reduction through Targeted Data Analytics	Customer Service and Enablement	• Identify strategic customers and target demand reduction in local areas by combining and integrating multiple Demand Side Management technologies (e.g., Energy Efficiency (EE), Demand Response (DR), Distributed Energy Storage, Consumer oriented Energy Tools). • Investigate whether Pacific Gas and Electric Company can achieve a sufficient amount of demand reduction through visibility into the customer-side resources, and improve the reliability of customer-side resources at the local level in order to reschedule local capacity expansion expenditures. • This project addresses California Public Utilities Commission proceeding, Distribution Resources Plan R.14 08 013, by supporting the fair and transparent processes for Distributed Energy Resource (DER) deployment and integration.	• Develop a solution/tool that determines needed customer demand reduction individually and in aggregate at asset level, leveraging interval and Supervisory Control and Data Acquisition (SCADA) data. • Develop cross DER customer targeting to address forecasted capacity challenges at specific assets, for specific days and times of year, leveraging interval data and other customer attributes.
53	2nd Triennial (2015-2017)	PG&E	2.23 - Integrate Demand Side Approaches Into Utility Planning	Customer Service and Enablement	• This project will enhance Pacific Gas and Electric Company's ability to incorporate the growing usage of Distributed Energy Resources (DER) into distribution planning tools by developing new customer class load shapes that incorporate DERs, and a methodology for modeling DER deployment uncertainty at the circuit level. • The execution of this project addresses issues as identified in the following proceedings: Distribution Resources Plan R.14-08-013 and Assembly Bill 327 Section 769, which requires transparent and consistent methods to integrate cost effective DERs into the distribution planning process.	• Integrate a broader range of customer-side technologies and DER approaches into grid planning and operations in a least cost framework by enhancing distribution load forecasting tools to include new customer load shapes based on the usage of DERs and to model the uncertainty of DER deployment at the circuit level.
54	2nd Triennial (2015-2017)	PG&E	2.24 - Appliance Level Bill Disaggregation for Non-Residential Customers	Customer Service and Enablement	• Demonstrate the ability to use sub-minute level usage information to determine appliance load for non-residential customers.	N/A
55	2nd Triennial (2015-2017)	PG&E	2.25 - Enhanced Smart Grid Communications	Cross-Cutting/Foundational	• Evaluate license spectrum providers that have developed technologies offered on the Federal Communications Commission (FCC) license frequency range/spectrum.	N/A

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	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
52	2nd Triennial (2015-2017)	PG&E	2.22 - Demand Reduction through Targeted Data Analytics	• Create a data analytics platform capable of combining and analyzing multi structured data, linking to a variety of data sources. • Develop a method for identification, valuation, implementation, and tracking of targeted DERs. • Create a quantitative screening/rank order tool. • Develop actionable DER recommendations to customer outreach teams for reaching demand reduction goals.	2.5years	9/15/2015	No	Distribution; Demand-Side Management	$ 656,887	$1,734,000 - $2,120,000
53	2nd Triennial (2015-2017)	PG&E	2.23 - Integrate Demand Side Approaches Into Utility Planning	• Develop enhanced Customer and DER Load Shapes Catalog in PG&E's LoadSEER Planning Tool. • Incorporate DER Scenario Projections into LoadSEER. • Develop interface between LoadSEER and CYME for batch processing integration.	2.25 years	4/10/2015	No	Distribution; Demand-Side Management	$ 1,831,735	$2,831,000 - $3,461,000
54	2nd Triennial (2015-2017)	PG&E	2.24 - Appliance Level Bill Disaggregation for Non-Residential Customers	N/A	N/A	N/A	No	Demand-Side Management	$ -	$ -
55	2nd Triennial (2015-2017)	PG&E	2.25 - Enhanced Smart Grid Communications	N/A	N/A	N/A	No	Grid Operations/ Market Design; Distribution; Demand-Side Management	$ -	$ -

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
52	2nd Triennial (2015-2017)	PG&E	2.22 - Demand Reduction through Targeted Data Analytics	$ 750,245	$ 987,777	$ 1,738,022	$ 14,902	N/A	N/A	N/A	N/A
53	2nd Triennial (2015-2017)	PG&E	2.23 - Integrate Demand Side Approaches Into Utility Planning	$ 1,807,067	$ 1,304,382	$ 3,111,449	$ 8,188	N/A	N/A	N/A	N/A
54	2nd Triennial (2015-2017)	PG&E	2.24 - Appliance Level Bill Disaggregation for Non-Residential Customers	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
55	2nd Triennial (2015-2017)	PG&E	2.25 - Enhanced Smart Grid Communications	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
52	2nd Triennial (2015-2017)	PG&E	2.22 - Demand Reduction through Targeted Data Analytics	N/A	Filed for provisional patent for system and server for parallel processing mixed integer programs for load management in January 2019.	Sole Source to Teradata to reduce unnecessary IT redundancy by leveraging existing data platform and data connections rather than re-create them.	N/A
53	2nd Triennial (2015-2017)	PG&E	2.23 - Integrate Demand Side Approaches Into Utility Planning	Pay for Performance	N/A	Sole Source to Integral Analytics (IA) given they are the developer/vendor for LoadSEER, which is the tool that is being modified to achieve the goals of this project.	N/A
54	2nd Triennial (2015-2017)	PG&E	2.24 - Appliance Level Bill Disaggregation for Non-Residential Customers	N/A	N/A	N/A	N/A
55	2nd Triennial (2015-2017)	PG&E	2.25 - Enhanced Smart Grid Communications	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
52	2nd Triennial (2015-2017)	PG&E	2.22 - Demand Reduction through Targeted Data Analytics	N/A	N/A	N/A	N/A	Column applicable to CEC only
53	2nd Triennial (2015-2017)	PG&E	2.23 - Integrate Demand Side Approaches Into Utility Planning	N/A	N/A	N/A	No	Column applicable to CEC only
54	2nd Triennial (2015-2017)	PG&E	2.24 - Appliance Level Bill Disaggregation for Non-Residential Customers	N/A	N/A	N/A	N/A	Column applicable to CEC only
55	2nd Triennial (2015-2017)	PG&E	2.25 - Enhanced Smart Grid Communications	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
52	2nd Triennial (2015-2017)	PG&E	2.22 - Demand Reduction through Targeted Data Analytics	• 3a - Maintain/Reduce capital costs. • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid. • 7e - Development and incorporation of cost-effective demand response, demand side resource, and energy efficient resources. • 7h - Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies.	• Project completed in February 2019 • This project may result in the enhancement of utility distribution planning tools and processes by facilitating the identification of the lowest cost portfolio capable of deferring, or completely mitigating, asset upgrades. Project tools produced by EPIC 2.22 consider both traditional wires solutions and DER portfolios and allows Distribution Planners to complete advanced scenario analysis. • Following the development of these new capabilities, EPIC 2.22 tools and platforms were used to support PG&E's first Distribution Deferral Opportunity Report (DDOR). EPIC 2.22 was leveraged by PG&E to complete detailed analysis and scenario comparisons at low costs, in a timely fashion, and with a level of analytical rigor that exceed regulatory requirements. • Final Report included in 2018 EPIC Annual Report.
53	2nd Triennial (2015-2017)	PG&E	2.23 - Integrate Demand Side Approaches Into Utility Planning	• 1c - Avoided procurement and generation costs. • 3f - Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management. • 5c - Forecast accuracy improvement. • 7e - Development and incorporation of cost-effective demand response, demand side resources, and energy-efficient resources (Public Utilities Code § 8360).	• Project completed in 2017. • Final Report included in 2017 EPIC Annual Report.
54	2nd Triennial (2015-2017)	PG&E	2.24 - Appliance Level Bill Disaggregation for Non-Residential Customers	N/A	• Project not executed.
55	2nd Triennial (2015-2017)	PG&E	2.25 - Enhanced Smart Grid Communications	N/A	• Project not executed.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
56	2nd Triennial (2015-2017)	PG&E	2.26 - Customer & Distribution Automation Open Architecture Devices	Cross-Cutting/Foundational	• Demonstrate the means by which new customer and distribution devices could interoperate with Pacific Gas and Electric Company's Advanced Metering Infrastructure (AMI) network (IPv6).	• Demonstrate the methodology, protocols, and standards for customers and vendors to connect and communicate various new devices and applications (e.g., Home Area Network, Electric Vehicle charging, smart appliances, etc.) with the AMI network (IPv6) in an effective manner.
57	2nd Triennial (2015-2017)	PG&E	2.27 - Next Generation Integrated Smart Grid Network Management	Cross-Cutting/Foundational	• Evaluate new technologies to holistically monitor, control and evolve the communications network and supporting infrastructure as a platform to enable Smart Grid solutions.	• Demonstrate a new Advanced Metering Infrastructure (AMI) Network management system to holistically monitor, control, and evolve the existing AMI network and infrastructure from a billing-centric platform to a fully operational AMI solutions platform that will meet evolving customer and grid needs.
58	2nd Triennial (2015-2017)	PG&E	2.28 - Smart Grid Communications Path Monitoring	Cross-Cutting/Foundational	• Evaluate communication paths for AMI related messages, including methods to clear potential interference, congestion, validate proper authorizations, and grant clearances for sending message over a secured communication path.	• Determine the ability to identify, analyze, and diagnose Radio Frequency interference that can occur along the communication path from the meter through the data collectors to the AMI vendors' control system.

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
56	2nd Triennial (2015-2017)	PG&E	2.26 - Customer & Distribution Automation Open Architecture Devices	• Conduct testing that will certify customer open architecture devices/applications that are AMI compatible, secure and interoperable. • Provide physical and application interfaces, as a proof of concept, which may permit customer and third party devices to connect to our AMI network(s).	3.25 years	9/15/2015	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$ 1,505,338	$3,015,000 - $3,685,000
57	2nd Triennial (2015-2017)	PG&E	2.27 - Next Generation Integrated Smart Grid Network Management	• Demonstrate an integrated, multi-tenant network management system that may include the following features: - Integrated network management & control that will monitor and prioritize data traffic. - Automate trouble ticketing creation process for workflow management. - Asset management of meter and network equipment regardless of meter or network types.	3 years	4/10/2015	No	Grid Operations/Market Design; Distribution; Demand-Side Management	$ 576,433	$1,008,000 - $1,232,000
58	2nd Triennial (2015-2017)	PG&E	2.28 - Smart Grid Communications Path Monitoring	• Establish the base line noise floor. • Develop and demonstrate an application with an algorithm which can automatically and continuously identify, monitor, and confirm RF interferences for multiple spectrums. • Provide an end-end process for identifying, confirming and mitigating detected interferences with the AMI-network.	1 year	1/6/2017	No	Grid Operation/Market Design	$ 58,518	$227,000 - $277,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
56	2nd Triennial (2015-2017)	PG&E	2.26 - Customer & Distribution Automation Open Architecture Devices	$ 1,136,568	$ 2,294,414	$ 3,430,982	$ 109,170	N/A	N/A	N/A	N/A
57	2nd Triennial (2015-2017)	PG&E	2.27 - Next Generation Integrated Smart Grid Network Management	$ 564,635	$ 569,510	$ 1,134,144	$ 6,363	N/A	N/A	N/A	N/A
58	2nd Triennial (2015-2017)	PG&E	2.28 - Smart Grid Communications Path Monitoring	$ 63,687	$ 188,182	$ 251,869	$ 7,236	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
56	2nd Triennial (2015-2017)	PG&E	2.26 - Customer & Distribution Automation Open Architecture Devices	N/A	Non-provisional patent filed for AMI network Open Architecture System	Compeititive Bid	N/A
57	2nd Triennial (2015-2017)	PG&E	2.27 - Next Generation Integrated Smart Grid Network Management	Pay for Performance	N/A	Competitive Bid	8
58	2nd Triennial (2015-2017)	PG&E	2.28 - Smart Grid Communications Path Monitoring	N/A	N/A	N/A	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
56	2nd Triennial (2015-2017)	PG&E	2.26 - Customer & Distribution Automation Open Architecture Devices	Errigal Inc.	2	Supplier selected had best prices for Use Cases that were selected for award.	No	Column applicable to CEC only
57	2nd Triennial (2015-2017)	PG&E	2.27 - Next Generation Integrated Smart Grid Network Management	Errigal Inc.	1	N/A	Yes	Column applicable to CEC only
58	2nd Triennial (2015-2017)	PG&E	2.28 - Smart Grid Communications Path Monitoring	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
56	2nd Triennial (2015-2017)	PG&E	2.26 - Customer & Distribution Automation Open Architecture Devices	• 3f - Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management. • 5i - Increase in the number of nodes in the power system at monitoring points. • 7j - Provide consumers with timely information and control options.	• Project completed in February 2019. • This project successfully demonstrated in laboratory and field tests, the ability to communicate with, monitor, and control PG&E and third-party devices in five use cases. • These use cases involved Smart Inverters, sensors, SCADA and other distribution intelligent electric devices (IEDs), RFID equipment and Direct Acquisition and Control Telemetry. • These use cases were selected for their potential to improve system reliability, reduce costs, or both. • This project was successful in demonstrating that PG&E's AMI network can be leveraged for these additional use cases and is suitable for connecting and transmitting data from customer and utility devices. • Final report included in 2018 EPIC Annual report.
57	2nd Triennial (2015-2017)	PG&E	2.27 - Next Generation Integrated Smart Grid Network Management	• 3a - Maintain/Reduce operations and maintenance costs. • 5a - Outage number, frequency and duration reductions. • 5d - Public safety improvement and hazard exposure reduction. • 5e - Utility worker safety improvement and hazard exposure reduction.	• Project completed in August 2018. • Developed a demonstration grade management platform that successfully identified inventory, configuration, and performance data for all three AMI networks including both networking elements and metering endpoints. • The project learned the complexity of adding functions needed such as additional Head-End Network Management functions, integration with GIS layers (i.e., data sources like CC&B, MDMS), and integration with various PG&E ticketing systems (Remedy, FAS). Based on this complexity, an enterprise management system will be needed to scale the functions demonstrated through this project. • Final report included in 2018 EPIC Annual report.
58	2nd Triennial (2015-2017)	PG&E	2.28 - Smart Grid Communications Path Monitoring	• 1h - Customer bill savings (dollars saved). • 3e - Non-energy economic benefits – reduction operational hours to fix estimated bills due to RF Interference.	• Project completed in February 2018 • Final Report included in 2017 EPIC Annual Report

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
59	2nd Triennial (2015-2017)	PG&E	2.29 - Mobile Meter Applications	Cross-Cutting/Foundational	• Demonstrate the utility's ability to enable dynamic electric mobile metering.	• Develop and test a mobile meter prototype on various applications that can be used to capture and monitor real-time energy transactions and usage (e.g. Plug-In Electric Vehicles (PEV), Distributed Generation (DG), mobile storage, etc.).
60	2nd Triennial (2015-2017)	PG&E	2.30 - Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs	Grid Modernization and Optimization	• Leverage EPIC dollars by participating and collaborating in multi-utility, industry wide research, demonstration and deployment initiatives conducted by third party organizations.	N/A
61	2nd Triennial (2015-2017)	PG&E	2.31 - Aggregated Behind-The-Meter Storage Market / Retail Optimization	Renewables/DER Resource Integration	• Demonstrate how aggregated behind-the-meter energy storage systems that are operated by a third party dispatcher may address wholesale market needs, while also operating as a customer resource to reduce customers' retail electric bills.	N/A
62	2nd Triennial (2015-2017)	PG&E	2.32 - Electric Load Management for Ridesharing Electrification	Renewables/DER Resource Integration	• Evaluate grid impacts from Electric Vehicle (EV) charging used for ridesharing applications, to assess the ability to manage the resulting load using active demand management.	N/A
63	2nd Triennial (2015-2017)	PG&E	2.33 - Service Issue Identification Leveraging Momentary Outage Information	Grid Modernization and Optimization	• Leverage multiple sources of data, including but not limited to SmartMeter™, time of day, location and weather data, to proactively identify potential problems in the Electric Transmission and Distribution (T&D) system, specifically related to identifying locations with high incidences of momentary outages which may be caused by imminent failures of conductors, insulators, transformers and/or vegetation contact.	N/A

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	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
59	2nd Triennial (2015-2017)	PG&E	2.29 - Mobile Meter Applications	• Design specification of mobile meter. • Demonstration of mobile meter hardware prototype. • End-to-end meter to cash testing using existing AMI or cellular based network. • Demonstration of use cases on DG applications and PEV metering, including remote and near real-time tracking of vehicle charge locations and energy flow.	3.5years	4/10/2015	No	Grid Operations/Market Design; Distribution; Demand-Side Management	$ 1,709,700	$2,610,000 - $3,190,000
60	2nd Triennial (2015-2017)	PG&E	2.30 - Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs	N/A	N/A	NA	No	Grid Operations/ Market Design; Transmission; Distribution; Demand-Side Management	$ -	$ -
61	2nd Triennial (2015-2017)	PG&E	2.31 - Aggregated Behind-The-Meter Storage Market / Retail Optimization	N/A	N/A	NA	N/A	Grid Operations/Market Design; Demand Side Management	$ -	$ -
62	2nd Triennial (2015-2017)	PG&E	2.32 - Electric Load Management for Ridesharing Electrification	N/A	N/A	NA	N/A	Grid Operations/Market Design; Distribution; Demand Side Management	$ -	$ -
63	2nd Triennial (2015-2017)	PG&E	2.33 - Service Issue Identification Leveraging Momentary Outage Information	N/A	N/A	NA	N/A	Grid Operations/Market Design; Distribution	$ -	$ -

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
59	2nd Triennial (2015-2017)	PG&E	2.29 - Mobile Meter Applications	$ 1,662,170	$ 905,544	$ 2,567,714	$ 56,768	In-kind services for resource time from Lawrence Livermore National Lab (LLNL) on technical specification calls	Lawrence Livermore National Lab providing technical support for product development	N/A	N/A
60	2nd Triennial (2015-2017)	PG&E	2.30 - Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
61	2nd Triennial (2015-2017)	PG&E	2.31 - Aggregated Behind-The-Meter Storage Market / Retail Optimization	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
62	2nd Triennial (2015-2017)	PG&E	2.32 - Electric Load Management for Ridesharing Electrification	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A
63	2nd Triennial (2015-2017)	PG&E	2.33 - Service Issue Identification Leveraging Momentary Outage Information	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

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Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
59	2nd Triennial (2015-2017)	PG&E	2.29 - Mobile Meter Applications	Pay for Performance	Patent 10,514,273 Smart Energy and Data/Information Metering System and Method was granted on December 24, 2019.	Competitive Bid	8
60	2nd Triennial (2015-2017)	PG&E	2.30 - Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs	N/A	N/A	N/A	N/A
61	2nd Triennial (2015-2017)	PG&E	2.31 - Aggregated Behind-The-Meter Storage Market / Retail Optimization	N/A	N/A	N/A	N/A
62	2nd Triennial (2015-2017)	PG&E	2.32 - Electric Load Management for Ridesharing Electrification	N/A	N/A	N/A	N/A
63	2nd Triennial (2015-2017)	PG&E	2.33 - Service Issue Identification Leveraging Momentary Outage Information	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
59	2nd Triennial (2015-2017)	PG&E	2.29 - Mobile Meter Applications	Ofer Communications	1	N/A	No	Column applicable to CEC only
60	2nd Triennial (2015-2017)	PG&E	2.30 - Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs	N/A	N/A	N/A	N/A	Column applicable to CEC only
61	2nd Triennial (2015-2017)	PG&E	2.31 - Aggregated Behind-The-Meter Storage Market / Retail Optimization	N/A	N/A	N/A	N/A	Column applicable to CEC only
62	2nd Triennial (2015-2017)	PG&E	2.32 - Electric Load Management for Ridesharing Electrification	N/A	N/A	N/A	N/A	Column applicable to CEC only
63	2nd Triennial (2015-2017)	PG&E	2.33 - Service Issue Identification Leveraging Momentary Outage Information	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
59	2nd Triennial (2015-2017)	PG&E	2.29 - Mobile Meter Applications	• 3a - Maintain/Reduce operations and maintenance costs (Affordability). • 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Reliability). • 7j - Provide consumers with timely information and control options (Customer).	• Project completed in February 2019. • Conducted functional and acceptance testing on alpha and beta NGM prototypes. • Demonstrated mobile application of NGM prototype at PG&E • Refined integration of accelerometer into the NGM • Designed, implemented, and tested C12.19 and head end applications into NGM • Final report included in 2018 EPIC Annual report.
60	2nd Triennial (2015-2017)	PG&E	2.30 - Leverage EPIC Funds to Participate in Industry-Wide RD&D Programs	N/A	• Project not executed.
61	2nd Triennial (2015-2017)	PG&E	2.31 - Aggregated Behind-The-Meter Storage Market / Retail Optimization	N/A	• Formally Withdrawn by PG&E on 07/31/2017 via PG&E Comments on Draft Resolution E-4863
62	2nd Triennial (2015-2017)	PG&E	2.32 - Electric Load Management for Ridesharing Electrification	N/A	• Deferred to a future investment plan by CPUC. Resolution E-4863. 08/10/2017. • Re-assigned as EPIC 3.42.
63	2nd Triennial (2015-2017)	PG&E	2.33 - Service Issue Identification Leveraging Momentary Outage Information	N/A	• Deferred to a future investment plan by CPUC. Resolution E-4863. 08/10/2017 • Re-assigned as EPIC 3.43.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
64	2nd Triennial (2015-2017)	PG&E	2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	Grid Modernization and Optimization	• Demonstrate distribution sensor products that provide indicators of imminent asset failure and real-time monitoring of PG&E rights-of-way	• Assess technical feasibility of various sensor products and validate opportunity for business benefits • Develop solution designs, develop test plans, and conduct testing at ATS • Conduct field demonstrations of various products and develop post-EPIC roadmaps for integrating capabilities in production
65	2nd Triennial (2015-2017)	PG&E	2.35 - Call Center Staffing Optimization	Grid Modernization and Optimization	• Optimize call center staffing by developing a real-time algorithm that integrates with and improves upon existing call center staffing software to potentially predict variability in call volume impacts in near real-time.	N/A

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	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
64	2nd Triennial (2015-2017)	PG&E	2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	• Roadmap for integrating additional sensor technologies in production	1year	8/10/2017	No	Grid Operations/Market Design; Distribution	$ 2,370,131	$1,655,000 - $2,023,000
65	2nd Triennial (2015-2017)	PG&E	2.35 - Call Center Staffing Optimization	N/A	N/A	NA	N/A	Grid Operations/Market Design	$ -	$ -

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	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
64	2nd Triennial (2015-2017)	PG&E	2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	$ 1,929,988	$ 1,217,017	$ 3,147,006	$ 46,920	N/A	N/A	N/A	N/A
65	2nd Triennial (2015-2017)	PG&E	2.35 - Call Center Staffing Optimization	$ -	$ -	$ -	$ -	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
64	2nd Triennial (2015-2017)	PG&E	2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	N/A	N/A	Direct Award to Texas A&M to compare DFA technology to IND.T's EFD technology. Rather than detecting RF signals, these substation-mounted devices use pattern recognition and advanced signal processing of voltage and current waveforms. It is considered an alternative solution for incipient fault detection Direct Award to IND.T due to good fit with objective of project and pre-commercial state of technology.	N/A
65	2nd Triennial (2015-2017)	PG&E	2.35 - Call Center Staffing Optimization	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
64	2nd Triennial (2015-2017)	PG&E	2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	N/A	N/A	N/A	N/A	Column applicable to CEC only
65	2nd Triennial (2015-2017)	PG&E	2.35 - Call Center Staffing Optimization	N/A	N/A	N/A	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
64	2nd Triennial (2015-2017)	PG&E	2.34 - Predictive Risk Identification with Radio Frequency (RF) Added to Line Sensors	• 3a - Maintain / Reduce operations and maintenance costs • 5a - Outage number, frequency and duration reductions • 5d - Public safety improvement and hazard exposure reduction	• Project is in the Build/Test phase. • Completed field testing of mobile RF-based sensors. • Field demonstration of Early Fault Detection system underway on live distribution circuits. Technology employs use of pole-mounted RF-based sensors for incipient fault detection. Testing to be completed by June 2020. • Field demonstration of Distribution Fault Anticipation (DFA) technology underway. DFA analyzes voltage and current waveform data to detect faults using equipment installed at substations. Testing to be completed by June 2020.
65	2nd Triennial (2015-2017)	PG&E	2.35 - Call Center Staffing Optimization	N/A	• Rejected by CPUC. Resolution E-4863. 08/10/2017

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
66	2nd Triennial (2015-2017)	PG&E	2.36 - Dynamic Rate Design Tool	Customer Service and Enablement	• Develop a new rate design tool that will enable complex rate design such as for DER adoption, with a more robust, quicker and powerful rate design approach than the current rate design process. Leveraging big data technologies the tool will provide rapid optimization, analysis and evaluation of hypothetical new rate structures which will enable PG&E and parties in a rate case to make rate design decisions based on full information and nuanced sensitivity analysis	• Design and build cost of service database • Design and build rate design model engine and API • Build functionality and ability to run DER scenarios
67	3rd Triennial (2018-2020)	PG&E	3.01 - Automated DER impact	Renewables/DER Resource Integration	Automate the DER impact and long term dynamics evaluation processes leveraged in detailed engineering analysis in order to aim to reduce DER study timelines and costs, while also seeking to support distribution engineers to better understand and manage the voltage impacts caused by multiple DERs on a single circuit and on Load Tap Changer (LTC) operations. The automated evaluation modules would produce a report showing device loading, steady state voltage analysis, and voltage flicker analysis. The long term dynamics module could potentially further identify potential voltage issues that may lead to Electric Rule 2 violations.	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
66	2nd Triennial (2015-2017)	PG&E	2.36 - Dynamic Rate Design Tool	• Technical architecture specifications • Data model and databases • Rate design model engine and API	1.25years	8/10/2017	No	Grid Operations/Market Design; Demand Side Management	$ 585,440	$1,913,000 - $2,338,000
67	3rd Triennial (2018-2020)	PG&E	3.01 - Automated DER impact	TBD	TBD	N/A	N/A		$ -	$ -

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For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
66	2nd Triennial (2015-2017)	PG&E	2.36 - Dynamic Rate Design Tool	$ 511,723	$ 595,686	$ 1,107,409	$ 3,255	N/A	N/A	N/A	N/A
67	3rd Triennial (2018-2020)	PG&E	3.01 - Automated DER impact	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
66	2nd Triennial (2015-2017)	PG&E	2.36 - Dynamic Rate Design Tool	Pay for Performance	N/A	N/A	N/A
67	3rd Triennial (2018-2020)	PG&E	3.01 - Automated DER impact	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
66	2nd Triennial (2015-2017)	PG&E	2.36 - Dynamic Rate Design Tool	N/A	N/A	N/A	N/A	Column applicable to CEC only
67	3rd Triennial (2018-2020)	PG&E	3.01 - Automated DER impact	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
66	2nd Triennial (2015-2017)	PG&E	2.36 - Dynamic Rate Design Tool	6a. Reduction of time to complete the process of designing, optimizing, and analyzing the impact of a hypothetical rate design	• Project is in Close-out phase. • Created technical architecture • Developed customer, meter and cost of service databases • Developed customer segmentation, bill determinant, rate schedule, bill calculation and rate solver modules that integrate the steps for rate design • Developed rate evaluation module including bill impact, bill volatility and energy burden • Completed E1, TOU and hypothetical DER Rates • Completed validation and acceptance testing
67	3rd Triennial (2018-2020)	PG&E	3.01 - Automated DER impact	TBD	• Project is currently on hold.

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
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Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
68	3rd Triennial (2018-2020)	PG&E	3.02 - DER to Market	Renewables/DER Resource Integration	Demonstrate multi-technology DER aggregation (e.g., solar, storage) for wholesale market operations with potential to explore multiple uses including distribution support, retail, and/or T&D interfaces for control center operations. Developing this more automated optimization solution may enable realization of additional value from DERs with minimal operator intervention or disruption to operations. This equals more effective utilization of distributed generation assets, which may include enhanced bidding in real-time to enable realization of additional wholesale market value from DERs or enhanced reliability by providing an indication of whether the current state of the grid is configured in a way that allows bidding into the CAISO market.	Develop a wholesale market optimization model for DERs, using an aggregation of two or more DERs.
69	3rd Triennial (2018-2020)	PG&E	3.03 - Advanced DERMS and ADMS	Renewables/DER Resource Integration	To incorporate additional DER technologies and grid management approaches into DERMS and/or ADMS to build upon efforts from the EPIC 2.02 DERMS project to support improvements to safe and reliable grid operations at the T&D market interface, while also enabling the presence of high penetrations of market participating DERs. This would demonstrate the orchestration of a comprehensive DER portfolio and also address the new operational challenges for Distribution Operators (DOs) caused by emerging opportunities for DERs to participate in wholesale markets via the DERP tariff.	Project Phase 1 – DER Registration, Verification, and Monitoring: -Design, assess, procure, and deploy a standardized SI head-end platform to communicate with a minimum of 2 individual DERs or Aggregator cloud platforms. The interface must be compliant with CSIP 2.1 requirements to enable vendor agnostic communication and be cybersecure. -Design, develop, and deploy an interface between SI head-end platform and DMS/SCADA to enable operator visibility of DER telemetry information. Conduct a field demonstration for the following foundational capability with multiple (at least two) individual DERs or Aggregators: -Dispatch registration data request to SI-based DERs, and ingest monitoring and registration data from DERs. -Display DER telemetry data in distribution DMS/SCADA for operator visibility Project Phase 2 – Integration with EMS/DMS/SCADA and DER dispatch: -Expand SI head-end platform capabilities to dispatch control signals to SI-based DERs either directly or through Aggregator cloud platforms. The interface must be compliant with CSIP 2.1 requirements and the control capabilities must include: oDispatch of real-time signal to connect/disconnect DERs oDispatch of real-time signal to limit maximum active power oDispatch of day-ahead capacity constraint signals oDispatch of seasonal or day-ahead load/generation

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
68	3rd Triennial (2018-2020)	PG&E	3.02 - DER to Market	TBD	TBD	N/A	N/A		$ -	$ -
69	3rd Triennial (2018-2020)	PG&E	3.03 - Advanced DERMS and ADMS	PHASE I -Detailed scope and charter created and approved -Location/feeder selection finalized for each use case -Initial solution design completed, and RFP released for DERMS vendor -DERMS vendor selected and contract terms finalized June -Multiple (at least two) individual DERs and/or aggregators contracted for participating in field demonstration – -Vendor software acceptance test completed for Phase 1 functionalities -DER assets deployed, and Aggregator platforms prepared for field demonstration -Demonstration of Phase 1 functionalities completed – April 2020 -Established operating protocol and procedure. Prepared path to production documentation for Phase 1 functionalities PHASE II -System requirements developed to expand the SI Head-end platform capabilities to establish two-way communication for demonstrating Phase 2 use cases -Vendor software acceptance test completed for Phase 2 functionalities -DER assets deployed, and Aggregator platforms prepared for field demonstration at one remote grid site and one Non-Wires alternative site. The NWA field demonstration will be conducted in an area that will allow PG&E to de-riskthe grid and/or PG&E customers. The field demonstration will be located either serve a grid need in an area with high potential to be affected by PSPS but not eligible as a resilience zone or in an area that is part of a disadvantaged community. The business sponsor will review and agree on site selection for both field deployments before they occur	2 Years	6/13/2019	No		$ 363,600	$3,547,000 - $4,335,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
68	3rd Triennial (2018-2020)	PG&E	3.02 - DER to Market	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
69	3rd Triennial (2018-2020)	PG&E	3.03 - Advanced DERMS and ADMS	$ 70,673	$ 549,550	$ 620,223	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
68	3rd Triennial (2018-2020)	PG&E	3.02 - DER to Market	TBD	TBD	TBD	TBD
69	3rd Triennial (2018-2020)	PG&E	3.03 - Advanced DERMS and ADMS	TBD	TBD	Direct Award to DC Systems Rationale: 1) The other possible vendor will not be able to work within the EPIC 3.03 timeline 2) PG&E does not have any IT infrastructure for other possible vendor. Difficulties deploying and integrating the other possible platform. Direct Award toQuality Logic Rationale: Award <$75K, direct awarded for speed and saving admin cost	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
68	3rd Triennial (2018-2020)	PG&E	3.02 - DER to Market	TBD	TBD	TBD		Column applicable to CEC only
69	3rd Triennial (2018-2020)	PG&E	3.03 - Advanced DERMS and ADMS	N/A	N/A	N/A	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
68	3rd Triennial (2018-2020)	PG&E	3.02 - DER to Market	TBD	• Project is currently on hold.
69	3rd Triennial (2018-2020)	PG&E	3.03 - Advanced DERMS and ADMS	7-b: Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360) 7-c: 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 (PU Code § 8360) 7-d: Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360) 7-j: Provide consumers with timely information and control options (PU Code § 8360) 7-l: Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services (PU Code § 8360) 9-c: Number of times reports are cited in scientific journals and trade publications for selected projects. 9-d: Successful project outcomes ready for use in California IOU grid (Path to market)	• Project approved and started in July 2019 • This project will design, procure, and deploy a prototype of an enterprise DERMS platform to develop a cost effective non-SCADA solution for providing situational awareness and control capabilities for operators to manage DERs, dispatch DER Registration data requests and monitor Smart Inverter-based DERs through head-end platform, and provide an interface to dispatch DERs as a remote grid and non-wires alternative (NWA).

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
70	3rd Triennial (2018-2020)	PG&E	3.04 - Digital Ledger	Renewables/DER Resource Integration	Demonstrate and evaluate a multi-nodal digital distributed ledger (i.e., Blockchain) as an enabling technology that may facilitate greater efficiency, transparency, and security for customers. The project results may illuminate certain blockchain use cases that provide the most benefit to the utility and its customers and provide greater understanding regarding challenges associated with technology scalability, the blockchain interface with the grid, and current business processes and the application of smart contracts and other similar algorithms in a distributed environment.	Build blockchain solution for materials traceability by tracking the company's use of steel reels. Build blockchain solution for the trading of incremental EV credits in the residential market for LCFS.
71	3rd Triennial (2018-2020)	PG&E	3.05 - Virtual DER Markets	Renewables/DER Resource Integration	To demonstrate the feasibility and the technological and/or economic performance of autonomous distributed economic dispatch in the context of DER markets for capacity and other attributes. There is no technology standard in the industry today for responding to multiple conflicting signals across the Generation-Transmission-Distribution-Customer (GTDC) value chain. The objective of the project is to test flexible demand, generation and storage, and reward local people and businesses for being more flexible with their energy.	TBD
72	3rd Triennial (2018-2020)	PG&E	3.06 - Auto ID of BTM Storage	Renewables/DER Resource Integration	To bridge the knowledge gap for storage's charge and discharge behavior in the field, as well as system impacts by analyzing storage charge/discharge patterns. Under current Net Energy Metering Policy, BTM Storage is not required to be on a separate sub-meter. This could lead to a situation where the utility would not be aware of the presence of storage, which could potentially impact safety and reliability of the distribution network. Additionally, understanding of the "net" storage impact at the feeder-level and secondary circuit level is important as distribution planning engineers begin to include DERs in their load forecasts.	TBD
73	3rd Triennial (2018-2020)	PG&E	3.07 - Storage for Load Balancing	Renewables/DER Resource Integration	To demonstrate phase load balancing by leveraging large, utility-owned batteries. Removing manual work to rebalance loads improves operational efficiency by reduced manual hours spent, improves reliability by optimizing asset utilization across phases with faster adjustment of controls, and improves safety by removing manual labor for managing large loads.	TBD

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Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
70	3rd Triennial (2018-2020)	PG&E	3.04 - Digital Ledger	TBD	18 months	N/A	N/A		$ -	$ -
71	3rd Triennial (2018-2020)	PG&E	3.05 - Virtual DER Markets	TBD	TBD	N/A	N/A		$ -	$ -
72	3rd Triennial (2018-2020)	PG&E	3.06 - Auto ID of BTM Storage	TBD	TBD	N/A	N/A		$ -	$ -
73	3rd Triennial (2018-2020)	PG&E	3.07 - Storage for Load Balancing	TBD	TBD	N/A	N/A		$ -	$ -

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(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
70	3rd Triennial (2018-2020)	PG&E	3.04 - Digital Ledger		$ (52)	$ (52)	$ -	TBD	TBD	TBD	TBD
71	3rd Triennial (2018-2020)	PG&E	3.05 - Virtual DER Markets	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
72	3rd Triennial (2018-2020)	PG&E	3.06 - Auto ID of BTM Storage	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
73	3rd Triennial (2018-2020)	PG&E	3.07 - Storage for Load Balancing	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
70	3rd Triennial (2018-2020)	PG&E	3.04 - Digital Ledger	TBD	TBD	TBD	TBD
71	3rd Triennial (2018-2020)	PG&E	3.05 - Virtual DER Markets	TBD	TBD	TBD	TBD
72	3rd Triennial (2018-2020)	PG&E	3.06 - Auto ID of BTM Storage	TBD	TBD	TBD	TBD
73	3rd Triennial (2018-2020)	PG&E	3.07 - Storage for Load Balancing	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
70	3rd Triennial (2018-2020)	PG&E	3.04 - Digital Ledger	TBD	TBD	TBD		Column applicable to CEC only
71	3rd Triennial (2018-2020)	PG&E	3.05 - Virtual DER Markets	TBD	TBD	TBD		Column applicable to CEC only
72	3rd Triennial (2018-2020)	PG&E	3.06 - Auto ID of BTM Storage	TBD	TBD	TBD		Column applicable to CEC only
73	3rd Triennial (2018-2020)	PG&E	3.07 - Storage for Load Balancing	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	*B*	*C*	*AC*	*AD*
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
70	3rd Triennial (2018-2020)	PG&E	3.04 - Digital Ledger	TBD	• Project is currently on hold.
71	3rd Triennial (2018-2020)	PG&E	3.05 - Virtual DER Markets	TBD	• Project is currently on hold.
72	3rd Triennial (2018-2020)	PG&E	3.06 - Auto ID of BTM Storage	TBD	• Project is currently on hold.
73	3rd Triennial (2018-2020)	PG&E	3.07 - Storage for Load Balancing	TBD	• Project is currently on hold.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
74	3rd Triennial (2018-2020)	PG&E	3.08 - Second Life Batteries	Renewables/DER Resource Integration	To demonstrate technology that enables second-life energy storage for key utility functions, such as DR and/or frequency regulation, which may lower energy storage costs and support EV business cases with residual value. Technology may also be developed for ensuring that second-life batteries can successfully interface with the grid. Building off PG&E's prior energy storage EPIC pilots, this project may identify significant technical or performance differentiations between a second-life storage system and an installation with new batteries, and	TBD
75	3rd Triennial (2018-2020)	PG&E	3.09 - Dynamic DER Forecasting	Renewables/DER Resource Integration	This project proposes to collect and combine smart inverter data with other data streams (e.g., local weather, customer demographics, and/or customer usage) to create an algorithm that can better predict customer gross and net usage/load, DER generation, back-feed at distribution assets, and impact on system level or local short-term energy supply needs. Beginning in September 2017, California's Rule 21 requires smart inverters for all new customer-connected generation and storage devices. Having better insight into the impact of DERs on generation and distribution system needs, the utility, in coordination with the CAISO, may be able to reduce the generation purchasing buffer required. Further, the utility could better understand and model/predict the impact of DERs on the distribution system. This could reduce operating cost and in turn potentially lower customer bills.	TBD
76	3rd Triennial (2018-2020)	PG&E	3.10 - Scenario Engine	Renewables/DER Resource Integration	To develop a wide-scale distribution and/or transmission grid simulator for analyzing multiple scenarios and potential future stressors to the grid, such as changes in usage behavior, increased DER integration rates and more to facilitate better informed grid planning.	TBD

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	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
74	3rd Triennial (2018-2020)	PG&E	3.08 - Second Life Batteries	TBD	TBD	N/A	N/A		$ -	$ -
75	3rd Triennial (2018-2020)	PG&E	3.09 - Dynamic DER Forecasting	TBD	TBD	N/A	N/A		$ -	$ -
76	3rd Triennial (2018-2020)	PG&E	3.10 - Scenario Engine	TBD	TBD	N/A	N/A		$ -	$ -

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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
74	3rd Triennial (2018-2020)	PG&E	3.08 - Second Life Batteries	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
75	3rd Triennial (2018-2020)	PG&E	3.09 - Dynamic DER Forecasting	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
76	3rd Triennial (2018-2020)	PG&E	3.10 - Scenario Engine	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
74	3rd Triennial (2018-2020)	PG&E	3.08 - Second Life Batteries	TBD	TBD	TBD	TBD
75	3rd Triennial (2018-2020)	PG&E	3.09 - Dynamic DER Forecasting	TBD	TBD	TBD	TBD
76	3rd Triennial (2018-2020)	PG&E	3.10 - Scenario Engine	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
74	3rd Triennial (2018-2020)	PG&E	3.08 - Second Life Batteries	TBD	TBD	TBD		Column applicable to CEC only
75	3rd Triennial (2018-2020)	PG&E	3.09 - Dynamic DER Forecasting	TBD	TBD	TBD		Column applicable to CEC only
76	3rd Triennial (2018-2020)	PG&E	3.10 - Scenario Engine	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
74	3rd Triennial (2018-2020)	PG&E	3.08 - Second Life Batteries	TBD	• Project is currently on hold.
75	3rd Triennial (2018-2020)	PG&E	3.09 - Dynamic DER Forecasting	TBD	• Project is currently on hold.
76	3rd Triennial (2018-2020)	PG&E	3.10 - Scenario Engine	TBD	• Project is currently on hold.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
77	3rd Triennial (2018-2020)	PG&E	3.11 - Location Targeted DERs	Renewables/DER Resource Integration	To create the processes and demonstrate the scoping, specification, and deployment of multiple DER technology configurations that could potentially serve as location-specific options for distribution system reliability and/or resilience upgrades.	Technology configurations to be evaluated for their ability to provide distribution service reliability and/or resilience may include distributed battery storage, distributed solar and other distributed generation, microgrid controllers, and isolation and protection equipment enabling islanding. If a microgrid alternative is identified and selected in the -41- distribution planning process, this project may include a field deployment and evaluation of the selected alternative. The relatively immature microgrid market is characterized by a wide range of custom projects with little standardization in technology and design. This project may help identify deployment options and test the efficacy of microgrid-related technologies (e.g., DERs, controllers, communications, and isolation and protective devices) in enhancing reliability and/or resilience in specific locations.
78	3rd Triennial (2018-2020)	PG&E	3.12 - Advanced VVO	Grid Modernization and Optimization	This project would seek to demonstrate enhanced algorithms to leverage VVO for grid management services.	TBD
79	3rd Triennial (2018-2020)	PG&E	3.13 - Transformer Monitoring - Sensors	Grid Modernization and Optimization	This project will seek to demonstrate equipment that can be quickly and safely mounted on the casing of a pole-top distribution transformer to enable monitoring of equipment health. Additionally, it may test new communication devices and processes for delivering sensor data through PG&E's FAN.	TBD
80	3rd Triennial (2018-2020)	PG&E	3.14 - Imminent Asset Risk	Grid Modernization and Optimization	To demonstrate the convergence of asset and operational data with historical maintenance information and proactive identification of potential equipment failures	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
77	3rd Triennial (2018-2020)	PG&E	3.11 - Location Targeted DERs	1.Initial microgrid designs and Wholesale Interconnection application support completed 2.Testbed design plan and initial DER component procurement 3.Experimental tariff frameworks for microgrid infrastructure cost recovery and islanding generation support (Initial Design) 4.Cybersecurity Protocols (initial Design with project partners) Interconnection and service planning requests completed 5.Test protocols for grid connected and islanded planned and unplanned simulations developed 6.The physical microgrid DER components in a PHIL simulation environment, including protections and local communication are developed 7.Field site and host circuit upgrades completed 8.Microgrid controller testing and verification completed 9.All microgrid components staged and ready for field deployment 10.Training for field and control center personnel completed 11.SCADA integration, automatic and manual operating protocol and procedure are established 12.Arcata airport microgrid field deployment and installation 13.Microgrid commissioning 14.Initial data collection and use-cases testing are completed 15.Public final report delivered	2 Years	4/1/2019	No	Grid Operations/ Market Design; Distribution; Demand-Side Management	$ 188,432	$1,980,000 - $2,412,000
78	3rd Triennial (2018-2020)	PG&E	3.12 - Advanced VVO	TBD	TBD	N/A	N/A		$ -	$ -
79	3rd Triennial (2018-2020)	PG&E	3.13 - Transformer Monitoring - Sensors	TBD	TBD	N/A	N/A		$ -	$1,137,000 - $1,331,000
80	3rd Triennial (2018-2020)	PG&E	3.14 - Imminent Asset Risk	TBD	TBD	N/A	N/A		$ -	$ -

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
77	3rd Triennial (2018-2020)	PG&E	3.11 - Location Targeted DERs	$ 181,947	$ 513,407	$ 695,354	$ -	TBD	TBD	TBD	TBD
78	3rd Triennial (2018-2020)	PG&E	3.12 - Advanced VVO	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
79	3rd Triennial (2018-2020)	PG&E	3.13 - Transformer Monitoring - Sensors	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
80	3rd Triennial (2018-2020)	PG&E	3.14 - Imminent Asset Risk	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
77	3rd Triennial (2018-2020)	PG&E	3.11 - Location Targeted DERs	TBD	TBD	Direct award to Tesla for a 57kW (228kWh) Powerpack 2.5 system Justification: - Tesla identified as the market leader in battery storage solutions.	TBD
78	3rd Triennial (2018-2020)	PG&E	3.12 - Advanced VVO	TBD	TBD	TBD	TBD
79	3rd Triennial (2018-2020)	PG&E	3.13 - Transformer Monitoring - Sensors	TBD	TBD	TBD	TBD
80	3rd Triennial (2018-2020)	PG&E	3.14 - Imminent Asset Risk	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
77	3rd Triennial (2018-2020)	PG&E	3.11 - Location Targeted DERs	TBD	TBD	TBD		Column applicable to CEC only
78	3rd Triennial (2018-2020)	PG&E	3.12 - Advanced VVO	TBD	TBD	TBD		Column applicable to CEC only
79	3rd Triennial (2018-2020)	PG&E	3.13 - Transformer Monitoring - Sensors	TBD	TBD	TBD		Column applicable to CEC only
80	3rd Triennial (2018-2020)	PG&E	3.14 - Imminent Asset Risk	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
77	3rd Triennial (2018-2020)	PG&E	3.11 - Location Targeted DERs	• 5a – Outage number, frequency and duration reductions • 5d – Public safety improvement and hazard exposure reduction • 9a – Description/documentation of projects that progress deployment, such as Commission approval of utility proposals for wide spread deployment or technologies included in adopted building standards	• Project is in Build/Test phase. • Location of the demonstration has been identified (Arcata/Eurkea airport). • Lab-scale testing of the microgrid controllers and battery storage solutions are in progress at PG&E (ATS) • Interconnect and design studies are being performed by PG&E, Humboldt State University, and Redwood Coast Energy Authority.
78	3rd Triennial (2018-2020)	PG&E	3.12 - Advanced VVO	TBD	• Project is currently on hold.
79	3rd Triennial (2018-2020)	PG&E	3.13 - Transformer Monitoring - Sensors	TBD	• Project is in planning phase. • Business plan is being drafted to plan for a field demonstration of approximately 500 temperature sensors to be installed on operational service transformers. • Project is planned to start in Q2 2020.
80	3rd Triennial (2018-2020)	PG&E	3.14 - Imminent Asset Risk	N/A	• Project merged with 3.20

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
81	3rd Triennial (2018-2020)	PG&E	3.15 - Proactive Wire Down	Grid Modernization and Optimization	Demonstrate methods for automatically & rapidly reducing the flow of current and risk of ignition in single phase to ground faults in PG&E's high risk fire areas. This project would test the hypothesis that resonance grounding can mitigate single line to ground fire ignition risk for 3-wire circuits in high fire risk areas. A secondary objective is to improve reliability during wildfire season over status quo, "trip feeder and drive entire line."	This project would seek to demonstrate technology that could identify a falling conductor in sub-second response time, to enable proactive circuit isolation. If proven successful, the algorithm could be integrated with grid management systems to minimize safety risks in wires down situations.
82	3rd Triennial (2018-2020)	PG&E	3.16 - Remote Diagnostics	Grid Modernization and Optimization	To demonstrate advanced real-time sensors for monitoring asset conditions, enabling an increasingly proactive maintenance and grid management operational model. If proven successful, these sensors could help PG&E estimate equipment's remaining service life, and predict when it may fail.	TBD
83	3rd Triennial (2018-2020)	PG&E	3.17 - Generic UDC	Grid Modernization and Optimization	Design and demonstrate a Universal Distribution Controller (UDC) that can act as a generic controller for use in electric distribution line equipment. This approach could potentially standardize controller hardware across operational control functions insuring interoperability and reducing the need for -51- redundant maintenance and management for multiple vendors. It may also permit customization of features through software development control specific to the utility's needs.	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
81	3rd Triennial (2018-2020)	PG&E	3.15 - Proactive Wire Down	Build, test, and make operationally ready the Rapid Earth Fault Current Limiter (REFCL) technology. Phase 1: Engineering and Construction • Project design •Equipment order • Test in Proof of Concept RTDS Lab • Field and substation work • Train and educate all departments affected by this technology Phase 2: Field Demonstration & Operation • Commissioning & testing • Fault location testing	2 years	11/28/2018	Yes	Grid Operations/Market Design; Distribution	$ 2,794,154	$7,560,000 - $9,240,000
82	3rd Triennial (2018-2020)	PG&E	3.16 - Remote Diagnostics	TBD	TBD	N/A	N/A		$ -	$ -
83	3rd Triennial (2018-2020)	PG&E	3.17 - Generic UDC	TBD	TBD	N/A	N/A		$ -	$ -

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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
81	3rd Triennial (2018-2020)	PG&E	3.15 - Proactive Wire Down	$ 1,000,350	$ 853,647	$ 1,853,997	$ 601	TBD	TBD	TBD	TBD
82	3rd Triennial (2018-2020)	PG&E	3.16 - Remote Diagnostics	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
83	3rd Triennial (2018-2020)	PG&E	3.17 - Generic UDC	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
81	3rd Triennial (2018-2020)	PG&E	3.15 - Proactive Wire Down	TBD	TBD	Direct Award to Swedish Neutral Justification: Supplier has a unique or highly specialized offering that is required for this individual project. Swedish Neutral is the only REFCL supplier with proven field installations of REFCL technology globally. PG&E is collaborating closely with Australian utilities who have deployed this technology in the field, and using the same supplier of the equipment is critical for this collaboration to work as PG&E moves forward with demonstrating and operationalizing this technology for reducing wildfire risk. Direct award is the best business decision until PG&E has a better understanding of this technology and other suppliers have proven themselves. The Victorian government has performed extensive testing of the Swedish Neutral GFN, and if PG&E went with a different supplier, it would add substantial testing cost to the project, which has been identified as out of scope in the business plan. Direct Award to Siemens Industry Justification: Award <$250K (PG&E program threshold for 2019), direct awarded for speed and saving admin cost Direct Award to Chain Link Fence & Supply Justification: Award <$250K (PG&E program threshold for 2019), direct awarded for speed and saving admin cost Various direct awards <$75K to a variety of companies for materials purchases, direct awarded for speed and saving admin cost	TBD
82	3rd Triennial (2018-2020)	PG&E	3.16 - Remote Diagnostics	TBD	TBD	TBD	TBD
83	3rd Triennial (2018-2020)	PG&E	3.17 - Generic UDC	TBD	TBD	TBD	TBD

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	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
81	3rd Triennial (2018-2020)	PG&E	3.15 - Proactive Wire Down	TBD	TBD	TBD		Column applicable to CEC only
82	3rd Triennial (2018-2020)	PG&E	3.16 - Remote Diagnostics	TBD	TBD	TBD		Column applicable to CEC only
83	3rd Triennial (2018-2020)	PG&E	3.17 - Generic UDC	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	*B*	*C*	*AC*	*AD*
For Report DOC	**i. Investment Plan Period**		**Project Name**	**vi. Metrics**	**xv. 2019 Status Update**
81	3rd Triennial (2018-2020)	PG&E	3.15 - Proactive Wire Down	• 3a – Maintain/Reduce operations and maintenance costs. • 4a – GHG Emissions Reductions (MMTCO2e) • 5a – Outage number, frequency and duration reductions	• Project is in the Build/Test phase. • Performed RFP process and identified equipment supplier for four key contracts. Execution of contracts begain in Q3 2019, and remaining contract that went through competitive process will be executed in Q1 2020. • Identified substation for demonstration and began civil engineering work to prepare the site. Distribution engineering and construction work to begin in mid 2020.
82	3rd Triennial (2018-2020)	PG&E	3.16 - Remote Diagnostics	TBD	• Project is currently on hold.
83	3rd Triennial (2018-2020)	PG&E	3.17 - Generic UDC	TBD	• Project is currently on hold.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
84	3rd Triennial (2018-2020)	PG&E	3.18 - Transformer Monitoring - Analytics	Grid Modernization and Optimization	To develop and demonstrate new algorithms for determining and actively monitoring transformer health and performance based on Synchrophasor or other technology to detect conditions, such as arcing, breaker mis-operation, or total fault energy over time. The project could enable higher accuracy asset monitoring and predictive failure analytics.	TBD
85	3rd Triennial (2018-2020)	PG&E	3.19 - Unified Communications	Grid Modernization and Optimization	To demonstrate a platform for unified communication among disparate networks both in the field, as well as across the enterprise. This project may improve reliability by ensuring communication service across multiple service platforms and help to reduce reliability risk by ensuring that the systems can rely on each other's backhaul for redundancy.	TBD
86	3rd Triennial (2018-2020)	PG&E	3.20 - Maintenance Analytics	Grid Modernization and Optimization	• To develop predictive maintenance algorithms for identifying potential asset failures before they occur by using SmartMeter™ voltage data and other utility data sources at service points downstream of equipment. The project would potentially improve system reliability and safety by reducing unplanned outages by proactively identifying and mitigating equipment failure.	• The project would define a set of failing equipment use cases that have impact on downstream voltage, and develop analytics algorithms to identify the voltage signatures associated with these upcoming failures. Examples of potential equipment use cases include primary side loose neutrals and overloaded or near-failure transformers, and stressed or near-failure cables.
87	3rd Triennial (2018-2020)	PG&E	3.21 - Vegetation Analytics	Grid Modernization and Optimization	To demonstrate a prescriptive analytics model that predicts tree growth rates and areas at highest risk for vegetation-related outages by leveraging Light Detection and Ranging (LiDAR), other remote sensing data, and historical vegetation based outages for proactive and targeted mitigation. The model could be used for routine maintenance activities, reliability-focused project planning, or planning and staging in anticipation of strong weather systems impacting the PG&E service system.	TBD
88	3rd Triennial (2018-2020)	PG&E	3.22 - Abnormal State Configurations	Grid Modernization and Optimization	To demonstrate an algorithm for understanding the comparative risk of abnormal state configurations to proactively prioritize mitigation of these issues. The project would explore the use of system data to analyze risk impact and attempt to demonstrate an algorithmic approach to automate the impact score. This project may also explore the best approaches to integrate this algorithm into utility systems and processes, as well as potentially automate the resolution of these issues.	TBD

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	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
84	3rd Triennial (2018-2020)	PG&E	3.18 - Transformer Monitoring - Analytics	TBD	TBD	N/A	N/A		$ -	$ -
85	3rd Triennial (2018-2020)	PG&E	3.19 - Unified Communications	TBD	TBD	N/A	N/A		$ -	$ -
86	3rd Triennial (2018-2020)	PG&E	3.20 - Maintenance Analytics	• The output of the project would be an analytics process that would correlate and detect pattern signatures that are associated to malfunctioning or failing system assets, a set of heuristics for identifying these signatures, and an evaluation of this technology's efficacy versus traditional condition based maintenance systems.	1.75 years	4/3/2019	No	Grid Operations/Market Design; Distribution	$ -	$1,881,000 - $2,300,000
87	3rd Triennial (2018-2020)	PG&E	3.21 - Vegetation Analytics	TBD	TBD	N/A	N/A		$ -	$2,443,000 - $2,860,000
88	3rd Triennial (2018-2020)	PG&E	3.22 - Abnormal State Configurations	TBD	TBD	N/A	N/A		$ -	$ -

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	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
84	3rd Triennial (2018-2020)	PG&E	3.18 - Transformer Monitoring - Analytics	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
85	3rd Triennial (2018-2020)	PG&E	3.19 - Unified Communications	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
86	3rd Triennial (2018-2020)	PG&E	3.20 - Maintenance Analytics	$ 5,759	$ 750,941	$ 756,701	$ -	TBD	TBD	TBD	TBD
87	3rd Triennial (2018-2020)	PG&E	3.21 - Vegetation Analytics	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
88	3rd Triennial (2018-2020)	PG&E	3.22 - Abnormal State Configurations	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	*B*	*C*	*S*	*T*	*U*	*V*
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
84	3rd Triennial (2018-2020)	PG&E	3.18 - Transformer Monitoring - Analytics	TBD	TBD	TBD	TBD
85	3rd Triennial (2018-2020)	PG&E	3.19 - Unified Communications	TBD	TBD	TBD	TBD
86	3rd Triennial (2018-2020)	PG&E	3.20 - Maintenance Analytics	TBD	TBD	TBD	TBD
87	3rd Triennial (2018-2020)	PG&E	3.21 - Vegetation Analytics	TBD	TBD	TBD	TBD
88	3rd Triennial (2018-2020)	PG&E	3.22 - Abnormal State Configurations	TBD	TBD	TBD	TBD

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Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
84	3rd Triennial (2018-2020)	PG&E	3.18 - Transformer Monitoring - Analytics	TBD	TBD	TBD		Column applicable to CEC only
85	3rd Triennial (2018-2020)	PG&E	3.19 - Unified Communications	TBD	TBD	TBD		Column applicable to CEC only
86	3rd Triennial (2018-2020)	PG&E	3.20 - Maintenance Analytics	TBD	TBD	TBD		Column applicable to CEC only
87	3rd Triennial (2018-2020)	PG&E	3.21 - Vegetation Analytics	TBD	TBD	TBD		Column applicable to CEC only
88	3rd Triennial (2018-2020)	PG&E	3.22 - Abnormal State Configurations	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
84	3rd Triennial (2018-2020)	PG&E	3.18 - Transformer Monitoring - Analytics	TBD	• Project is currently on hold.
85	3rd Triennial (2018-2020)	PG&E	3.19 - Unified Communications	TBD	• Project is currently on hold.
86	3rd Triennial (2018-2020)	PG&E	3.20 - Maintenance Analytics	•3a - Maintain / Reduce operations and maintenance costs •5a - Outage number, frequency and duration reductions •5d - Public safety improvement and hazard exposure reduction •7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)	• Project is in Build/Test phase • Identified three use cases to develop predictive analytics model. • Model currently under development for service tranformer use case using historical failure data. • Use cases on network transformers/regulators and underground cables to be explored.
87	3rd Triennial (2018-2020)	PG&E	3.21 - Vegetation Analytics	TBD	• Project is in planning phase
88	3rd Triennial (2018-2020)	PG&E	3.22 - Abnormal State Configurations	TBD	• Project is currently on hold.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	*B*	*C*	*D*	*E1*	*E2*
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
89	3rd Triennial (2018-2020)	PG&E	3.23 - Enhanced Line Settings	Grid Modernization and Optimization	To demonstrate the increased efficiency, quality assurance, and flexibility of technology to manage transmission and substation distribution protection relay device settings to all distribution line equipment relays and controllers	TBD
90	3rd Triennial (2018-2020)	PG&E	3.24 - Power Factor	Grid Modernization and Optimization	To demonstrate a software algorithm to achieve Automatic Power Factor Management to keep power factor within the mandated CAISO guideline.	TBD
91	3rd Triennial (2018-2020)	PG&E	3.25 - Grid Monitoring Meter	Customer Service and Enablement	• To develop and demonstrate a modular-designed meter with the capability to monitor electric grid operations and report real time outage and restoration, as well as function as a SCADA metering point during the critical and initial 10-30 minutes of a power outage. This may help keep PG&E distribution system operators well-informed of grid outage conditions and assist them in taking appropriate actions to restore customer power quickly. • The new meter demonstrated in this project could enable potential reduction of equipment costs for replacements due to its modular design. The base mechanical meter would more rarely need replacement, typically leaving just the replacement of the solid state meter and communication core component as needed.	TBD
92	3rd Triennial (2018-2020)	PG&E	3.26 - Analytics for Meter Replacement	Customer Service and Enablement	To develop and demonstrate a predictive analytics tool for remotely diagnosing meter health, to target and prioritize proactive meter replacements. The project will seek to explore the development and demonstration of an algorithm, software application/tool, and/or system interfaces to predict when a meter has a potentially unsafe condition, identify service connection issues, and/or identify when a meter is failing.	TBD
93	3rd Triennial (2018-2020)	PG&E	3.27 - Multi Purpose Meter	Customer Service and Enablement	To develop and demonstrate a meter that can measure energy consumption for multiple customers and/or multiple uses/purposes, in the place of multiple single-use/purpose and/or sub-meters. The Multi-Purpose Meter (MPM) will include a combination of head-end operations applications, master meter, and individual meters (IDV). This solution will cut down the components inside electric meters and reduce the material costs, meter installation and maintenance costs at the same premise. The combination of power enclosure and MPM box will also be small and take less space inside the building.	TBD

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
89	3rd Triennial (2018-2020)	PG&E	3.23 - Enhanced Line Settings	TBD	TBD	N/A	N/A		$ -	$ -
90	3rd Triennial (2018-2020)	PG&E	3.24 - Power Factor	TBD	TBD	N/A	N/A		$ -	$ -
91	3rd Triennial (2018-2020)	PG&E	3.25 - Grid Monitoring Meter	TBD	TBD	N/A	N/A		$ -	$ -
92	3rd Triennial (2018-2020)	PG&E	3.26 - Analytics for Meter Replacement	TBD	TBD	N/A	N/A		$ -	$ -
93	3rd Triennial (2018-2020)	PG&E	3.27 - Multi Purpose Meter	TBD	TBD	N/A	N/A		$ -	$3,311,000 - $4,047,000

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
89	3rd Triennial (2018-2020)	PG&E	3.23 - Enhanced Line Settings	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
90	3rd Triennial (2018-2020)	PG&E	3.24 - Power Factor	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
91	3rd Triennial (2018-2020)	PG&E	3.25 - Grid Monitoring Meter	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
92	3rd Triennial (2018-2020)	PG&E	3.26 - Analytics for Meter Replacement	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
93	3rd Triennial (2018-2020)	PG&E	3.27 - Multi Purpose Meter	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
89	3rd Triennial (2018-2020)	PG&E	3.23 - Enhanced Line Settings	TBD	TBD	TBD	TBD
90	3rd Triennial (2018-2020)	PG&E	3.24 - Power Factor	TBD	TBD	TBD	TBD
91	3rd Triennial (2018-2020)	PG&E	3.25 - Grid Monitoring Meter	TBD	TBD	TBD	TBD
92	3rd Triennial (2018-2020)	PG&E	3.26 - Analytics for Meter Replacement	TBD	TBD	TBD	TBD
93	3rd Triennial (2018-2020)	PG&E	3.27 - Multi Purpose Meter	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
89	3rd Triennial (2018-2020)	PG&E	3.23 - Enhanced Line Settings	TBD	TBD	TBD		Column applicable to CEC only
90	3rd Triennial (2018-2020)	PG&E	3.24 - Power Factor	TBD	TBD	TBD		Column applicable to CEC only
91	3rd Triennial (2018-2020)	PG&E	3.25 - Grid Monitoring Meter	TBD	TBD	TBD		Column applicable to CEC only
92	3rd Triennial (2018-2020)	PG&E	3.26 - Analytics for Meter Replacement	TBD	TBD	TBD		Column applicable to CEC only
93	3rd Triennial (2018-2020)	PG&E	3.27 - Multi Purpose Meter	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	*B*	*C*	*AC*	*AD*
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
89	3rd Triennial (2018-2020)	PG&E	3.23 - Enhanced Line Settings	TBD	• Project is currently on hold.
90	3rd Triennial (2018-2020)	PG&E	3.24 - Power Factor	TBD	• Project is currently on hold.
91	3rd Triennial (2018-2020)	PG&E	3.25 - Grid Monitoring Meter	TBD	• Project is currently on hold.
92	3rd Triennial (2018-2020)	PG&E	3.26 - Analytics for Meter Replacement	TBD	• Project is currently on hold.
93	3rd Triennial (2018-2020)	PG&E	3.27 - Multi Purpose Meter	TBD	• Project is in planning phase.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
94	3rd Triennial (2018-2020)	PG&E	3.28 - Load Based Charging	Customer Service and Enablement	The project would attempt to develop a smart-charging algorithm based on time, capacity, locations, and other inputs. The algorithm would aim to coordinate EV charging so that specific grid assets are not overly taxed. This project could design controls to coordinate EV charging in a local area in order to facilitate higher EV adoption and charging without the need for distribution system upgrades.	TBD
95	3rd Triennial (2018-2020)	PG&E	3.29 - Customer Bill Calculator	Customer Service and Enablement	To demonstrate an online tool with a streamlined graphical user interface to allow customers to more easily understand how behavioral changes and technology investments may affect their energy bill. The proposed tool is targeted towards the group of more engaged customers. PG&E's customer research shows that the more engaged customers want to understand how technologies may affect their bills. In response to this market need, this tool would allow consumers to engage with their energy usage and conservation options through an interactive and more in depth manner.	TBD
96	3rd Triennial (2018-2020)	PG&E	3.30 - Pricing Signals	Customer Service and Enablement	To demonstrate the technical feasibility, utility benefits, and customer value of real-time pricing services through evaluating how PG&E can send signals to connected devices to control their operation based on pricing signals and/or grid conditions. This project aims to investigate the strategies for potential future dynamic pricing options enabled by recent communication infrastructure solutions that tie real-time locational marginal electricity price to retail real-time pricing transmission at the interval level.	TBD
97	3rd Triennial (2018-2020)	PG&E	3.31 - Real Time DER Rates	Customer Service and Enablement	To design and demonstrate a locational net benefit rate design structure for DERs in order to valuate DER grid services to incentivize optimal DER siting and dispatch.	TBD
98	3rd Triennial (2018-2020)	PG&E	3.32 - System Harmonics	Customer Service and Enablement	To leverage SmartMeterTM data to assist in identifying system harmonics that may cause power quality issues for customers.	TBD
99	3rd Triennial (2018-2020)	PG&E	3.33 - Cyber-Physical Correlation	Cross-Cutting/Foundational	To demonstrate a unified security solution which matches physical access to system access to aid in the blocking of unauthorized access to PG&E's critical infrastructure.	TBD
100	3rd Triennial (2018-2020)	PG&E	3.34 - Wireless Security	Cross-Cutting/Foundational	To develop and demonstrate a next-generation wireless security solution which would monitor airwaves around PG&E's electric facilities to detect rogue access points installed within physically secured generation / substation facilities, which could provide bad actors access to the critical infrastructure networks	TBD

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
94	3rd Triennial (2018-2020)	PG&E	3.28 - Load Based Charging	TBD	TBD	N/A	N/A		$ -	$ -
95	3rd Triennial (2018-2020)	PG&E	3.29 - Customer Bill Calculator	TBD	TBD	N/A	N/A		$ -	$ -
96	3rd Triennial (2018-2020)	PG&E	3.30 - Pricing Signals	TBD	TBD	N/A	N/A		$ -	$ -
97	3rd Triennial (2018-2020)	PG&E	3.31 - Real Time DER Rates	TBD	TBD	N/A	N/A		$ -	$ -
98	3rd Triennial (2018-2020)	PG&E	3.32 - System Harmonics	TBD	TBD	N/A	N/A		$ -	$1,040,000 - $1,270,000
99	3rd Triennial (2018-2020)	PG&E	3.33 - Cyber-Physical Correlation	TBD	TBD	N/A	N/A		$ -	$ -
100	3rd Triennial (2018-2020)	PG&E	3.34 - Wireless Security	TBD	TBD	N/A	N/A		$ -	$ -

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
94	3rd Triennial (2018-2020)	PG&E	3.28 - Load Based Charging	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
95	3rd Triennial (2018-2020)	PG&E	3.29 - Customer Bill Calculator	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
96	3rd Triennial (2018-2020)	PG&E	3.30 - Pricing Signals	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
97	3rd Triennial (2018-2020)	PG&E	3.31 - Real Time DER Rates	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
98	3rd Triennial (2018-2020)	PG&E	3.32 - System Harmonics	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
99	3rd Triennial (2018-2020)	PG&E	3.33 - Cyber-Physical Correlation	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
100	3rd Triennial (2018-2020)	PG&E	3.34 - Wireless Security	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
94	3rd Triennial (2018-2020)	PG&E	3.28 - Load Based Charging	TBD	TBD	TBD	TBD
95	3rd Triennial (2018-2020)	PG&E	3.29 - Customer Bill Calculator	TBD	TBD	TBD	TBD
96	3rd Triennial (2018-2020)	PG&E	3.30 - Pricing Signals	TBD	TBD	TBD	TBD
97	3rd Triennial (2018-2020)	PG&E	3.31 - Real Time DER Rates	TBD	TBD	TBD	TBD
98	3rd Triennial (2018-2020)	PG&E	3.32 - System Harmonics	TBD	TBD	TBD	TBD
99	3rd Triennial (2018-2020)	PG&E	3.33 - Cyber-Physical Correlation	TBD	TBD	TBD	TBD
100	3rd Triennial (2018-2020)	PG&E	3.34 - Wireless Security	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
94	3rd Triennial (2018-2020)	PG&E	3.28 - Load Based Charging	TBD	TBD	TBD		Column applicable to CEC only
95	3rd Triennial (2018-2020)	PG&E	3.29 - Customer Bill Calculator	TBD	TBD	TBD		Column applicable to CEC only
96	3rd Triennial (2018-2020)	PG&E	3.30 - Pricing Signals	TBD	TBD	TBD		Column applicable to CEC only
97	3rd Triennial (2018-2020)	PG&E	3.31 - Real Time DER Rates	TBD	TBD	TBD		Column applicable to CEC only
98	3rd Triennial (2018-2020)	PG&E	3.32 - System Harmonics	TBD	TBD	TBD		Column applicable to CEC only
99	3rd Triennial (2018-2020)	PG&E	3.33 - Cyber-Physical Correlation	TBD	TBD	TBD		Column applicable to CEC only
100	3rd Triennial (2018-2020)	PG&E	3.34 - Wireless Security	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
94	3rd Triennial (2018-2020)	PG&E	3.28 - Load Based Charging	TBD	• Project is currently on hold.
95	3rd Triennial (2018-2020)	PG&E	3.29 - Customer Bill Calculator	TBD	• After nearly completing the business plan, this project was put on hold and is still currently on hold.
96	3rd Triennial (2018-2020)	PG&E	3.30 - Pricing Signals	TBD	• Project is currently on hold.
97	3rd Triennial (2018-2020)	PG&E	3.31 - Real Time DER Rates	TBD	• Project is currently on hold.
98	3rd Triennial (2018-2020)	PG&E	3.32 - System Harmonics	TBD	• Project is in planning phase.
99	3rd Triennial (2018-2020)	PG&E	3.33 - Cyber-Physical Correlation	TBD	• Project is currently on hold.
100	3rd Triennial (2018-2020)	PG&E	3.34 - Wireless Security	TBD	• Project is currently on hold.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
101	3rd Triennial (2018-2020)	PG&E	3.35 - Advanced Security for IoT	Cross-Cutting/Foundational	To demonstrate an open architecture standard for secure communications between a utility and customer devices using third party communication channels (e.g., home internet connections, cellular networks, private-built field area networks).	TBD
102	3rd Triennial (2018-2020)	PG&E	3.36 - Cyber for ICS	Cross-Cutting/Foundational	This EPIC project is proposed as a joint EPIC Administrator collaborative project that seeks to evaluate potential demonstrations that build on the foundation of machine to machine automated threat response by including adaptive controls & dynamic zoning for ICS. These would help to contain or thwart cyberattacks	TBD
103	3rd Triennial (2018-2020)	PG&E	3.37 - Augmented Reality	Cross-Cutting/Foundational	To demonstrate technology for visualizing grid and asset data integrated with the geographic information system (GIS) data, superimposed on a device to provide support and guidance for activities, such as asset investigations and maintenance. Augmented reality is a broad technology category which could improve the efficiency and affordability of field operations by providing faster access to key asset information during inspections and maintenance. Just as importantly, this could eventually improve field crew safety by providing hands-free information displays (e.g., through a heads up display).	TBD
104	3rd Triennial (2018-2020)	PG&E	3.38 - Voltage Checks	Cross-Cutting/Foundational	To demonstrate technology for visualizing grid and asset data integrated with the geographic information system (GIS) data, superimposed on a device to provide support and guidance for activities, such as asset investigations and maintenance. Augmented reality is a broad technology category which could improve the efficiency and affordability of field operations by providing faster access to key asset information during inspections and maintenance. Just as importantly, this could eventually improve field crew safety by providing hands-free information displays (e.g., through a heads up display).	TBD
105	3rd Triennial (2018-2020)	PG&E	3.39 - Optimized Restoration	Cross-Cutting/Foundational	To develop and demonstrate a tool for field workers to perform remote voltage checks and identify low or no-power line situations while on-site without the need to call the central office or manually measure the line. This could potentially enable a field or dispatch employee to identify Service Points and other voltage-checkable equipment in the surrounding area, click on one of the pieces of equipment, and request the current voltage flowing through this equipment to diagnose an issue	TBD

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	A	B	C	E3	E4	F	G	H	I	J
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
101	3rd Triennial (2018-2020)	PG&E	3.35 - Advanced Security for IoT	TBD	TBD	N/A	N/A		$ -	$ -
102	3rd Triennial (2018-2020)	PG&E	3.36 - Cyber for ICS	TBD	TBD	N/A	N/A		$ -	$ -
103	3rd Triennial (2018-2020)	PG&E	3.37 - Augmented Reality	TBD	TBD	N/A	N/A		$ -	$ -
104	3rd Triennial (2018-2020)	PG&E	3.38 - Voltage Checks	TBD	TBD	N/A	N/A		$ -	$ -
105	3rd Triennial (2018-2020)	PG&E	3.39 - Optimized Restoration	TBD	TBD	N/A	N/A		$ -	$ -

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
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Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
101	3rd Triennial (2018-2020)	PG&E	3.35 - Advanced Security for IoT	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
102	3rd Triennial (2018-2020)	PG&E	3.36 - Cyber for ICS	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
103	3rd Triennial (2018-2020)	PG&E	3.37 - Augmented Reality	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
104	3rd Triennial (2018-2020)	PG&E	3.38 - Voltage Checks	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
105	3rd Triennial (2018-2020)	PG&E	3.39 - Optimized Restoration	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

APPENDIX A
ELECTRIC PROGRAM INVESTMENT CHARGE
2019 ANNUAL REPORT
(CONTINUED)

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
101	3rd Triennial (2018-2020)	PG&E	3.35 - Advanced Security for IoT	TBD	TBD	TBD	TBD
102	3rd Triennial (2018-2020)	PG&E	3.36 - Cyber for ICS	TBD	TBD	TBD	TBD
103	3rd Triennial (2018-2020)	PG&E	3.37 - Augmented Reality	TBD	TBD	TBD	TBD
104	3rd Triennial (2018-2020)	PG&E	3.38 - Voltage Checks	TBD	TBD	TBD	TBD
105	3rd Triennial (2018-2020)	PG&E	3.39 - Optimized Restoration	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
101	3rd Triennial (2018-2020)	PG&E	3.35 - Advanced Security for IoT	TBD	TBD	TBD		Column applicable to CEC only
102	3rd Triennial (2018-2020)	PG&E	3.36 - Cyber for ICS	TBD	TBD	TBD		Column applicable to CEC only
103	3rd Triennial (2018-2020)	PG&E	3.37 - Augmented Reality	TBD	TBD	TBD		Column applicable to CEC only
104	3rd Triennial (2018-2020)	PG&E	3.38 - Voltage Checks	TBD	TBD	TBD		Column applicable to CEC only
105	3rd Triennial (2018-2020)	PG&E	3.39 - Optimized Restoration	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	B	C	AC	AD
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
101	3rd Triennial (2018-2020)	PG&E	3.35 - Advanced Security for IoT	TBD	• Project is currently on hold.
102	3rd Triennial (2018-2020)	PG&E	3.36 - Cyber for ICS	TBD	• Project is currently on hold.
103	3rd Triennial (2018-2020)	PG&E	3.37 - Augmented Reality	TBD	• Project is currently on hold.
104	3rd Triennial (2018-2020)	PG&E	3.38 - Voltage Checks	TBD	• Project is currently on hold.
105	3rd Triennial (2018-2020)	PG&E	3.39 - Optimized Restoration	TBD	• Project is currently on hold.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief Description of the Project - Objective	Brief Description of the Project - Scope
	A	B	C	D	E1	E2
For Report DOC	i. Investment Plan Period		Project Name		iii. Objective	iv. Scope
106	3rd Triennial (2018-2020)	PG&E	3.40 - Advanced Reference Tool	Cross-Cutting/Foundational	To optimize crew movements and responses during outage dispatch to support restoration operations.	TBD
107	3rd Triennial (2018-2020)	PG&E	3.41 - Drone Enablement	Cross-Cutting/Foundational	To develop and demonstrate a foundational utility-focused Drone enablement systems and initial use cases to form the foundation for future utility Drone operations. These devices have the potential to revolutionize monitoring, inspection, and real-time awareness of pipeline and powerline infrastructure in normal or outage conditions.	TBD
108	3rd Triennial (2018-2020)	PG&E	3.42 - Ridesharing Load Management	Renewables/DER Resource Integration	• Evaluate grid impacts from Electric Vehicle (EV) charging used for ridesharing applications, to assess the ability to manage the resulting load using active demand management.	TBD
109	3rd Triennial (2018-2020)	PG&E	3.43 - Momentary Outage Information	Grid Modernization and Optimization	To test and demonstrate the hypothesis that AMI momentary events ("blinks") and trap alarms correlate to and can be used to identify specific equipment failures and/or vegetation contact. The project will use the Agile methodology to develop analytical models that use AMI momentary events and trap alarms to identify issues with customer service drops, distribution equipment, and intermittent vegetation contact.	• Leverage multiple sources of data, including but not limited to SmartMeter™, time of day, location and weather data, to proactively identify potential problems in the Electric Distribution system, specifically related to identifying locations with high incidences of momentary outages which may be caused by imminent failures of conductors, insulators, transformers and/or vegetation contact.

Row #	Investment Program Period	Program Administrator	Project Name	Brief Description of the Project - Deliverables	Brief Description of the Project - Schedule (2016)	Date of the Award	Was This Project Awarded in the Immediately Prior Calendar Year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($) [1]	Committed Funding Amount ($)
	A	*B*	*C*	*E3*	*E4*	*F*	*G*	*H*	*I*	*J*
For Report DOC	i. Investment Plan Period		Project Name	v. Deliverables	vii. Schedule			ii. Assignment to Value Chain	viii. EPIC Funds Encumbered	
106	3rd Triennial (2018-2020)	PG&E	3.40 - Advanced Reference Tool	TBD	TBD	N/A	N/A		$ -	$ -
107	3rd Triennial (2018-2020)	PG&E	3.41 - Drone Enablement	TBD	TBD	N/A	N/A		$ -	$2,118,000 - $2,479,000
108	3rd Triennial (2018-2020)	PG&E	3.42 - Ridesharing Load Management	TBD	TBD	N/A	N/A	Grid Operations/Market Design; Distribution; Demand Side Management	$ -	$ -
109	3rd Triennial (2018-2020)	PG&E	3.43 - Momentary Outage Information	Primary deliverables include: * Correlation of events to geographic locations, equipment classes, and vintages, to identify areas and assets with systemic issues and/or higher likelihood of failures. * Development of analytical models to predict & identify the equipment source of momentary events "meter blinks" and voltage sags/swells as well as momentary loss of voltage. * Evaluation of performance of models on historical failures of assets or time frames which have been excluded from model development processes. * Field verifications/inspections of assets identified to be responsible for smart meter anomalies to validate the models' performance.	1.75 years	12/16/2019	No	Grid Operations/Market Design; Distribution	$ -	$615,000 - $751,000

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to Date: Contract/Grant Amount ($) 2	Funds Expended to Date: In House Expenditures ($) 2	Funds Expended to Date: Total Spent to Date ($)	Administrative and Overhead Costs to Be Incurred for Each Project	Leveraged Funds	Partners	Match Funding	Match Funding Split
	A	B	C	K	L	M	N	O	P	Q	R
For Report DOC	i. Investment Plan Period		Project Name			ix. EPIC Funds Spent			x. Partners (if applicable)	xi. Match Funding (if applicable)	xii. Match Funding Split (if applicable)
106	3rd Triennial (2018-2020)	PG&E	3.40 - Advanced Reference Tool	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
107	3rd Triennial (2018-2020)	PG&E	3.41 - Drone Enablement	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD
108	3rd Triennial (2018-2020)	PG&E	3.42 - Ridesharing Load Management	$ -	$ (3)	$ (3)	$ (3)	TBD	TBD	TBD	TBD
109	3rd Triennial (2018-2020)	PG&E	3.43 - Momentary Outage Information	$ -	$ -	$ -	$ -	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funding Mechanism	Intellectual Property	Identification of the Method Used to Grant Awards.	If Competitively Selected, Provide the Number of Bidders Passing the Initial Pass/Fail Screening for Project
	A	B	C	S	T	U	V
For Report DOC	i. Investment Plan Period		Project Name	xiii. Funding Mechanism (if applicable)	xiv. Treatment of Intellectual Property (if applicable)		
106	3rd Triennial (2018-2020)	PG&E	3.40 - Advanced Reference Tool	TBD	TBD	TBD	TBD
107	3rd Triennial (2018-2020)	PG&E	3.41 - Drone Enablement	TBD	TBD	TBD	TBD
108	3rd Triennial (2018-2020)	PG&E	3.42 - Ridesharing Load Management	TBD	TBD	TBD	TBD
109	3rd Triennial (2018-2020)	PG&E	3.43 - Momentary Outage Information	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If Competitively Selected, Provide the Name of Selected Bidder.	If Competitively Selected, Provide the Rank of the Selected Bidder in the Selection Process.	If Competitively Selected, Explain Why the Bidder Was Not the Highest Scoring Bidder, Explain Why a Lower Scoring Bidder Was Selected.	Does Award Recipient Identify as California-Based Entity, Small Business, Businesses Owned by Women, Minorities, or Disabled Veterans? Information Requested for Technology Vendor Procurements Only (i.e., Not PMs, Consulting Services, Etc.)	How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals
	A	*B*	*C*	*W*	*X*	*Y*	*AA*	*AB*
For Report DOC	i. Investment Plan Period		Project Name					
106	3rd Triennial (2018-2020)	PG&E	3.40 - Advanced Reference Tool	TBD	TBD	TBD		Column applicable to CEC only
107	3rd Triennial (2018-2020)	PG&E	3.41 - Drone Enablement	TBD	TBD	TBD		Column applicable to CEC only
108	3rd Triennial (2018-2020)	PG&E	3.42 - Ridesharing Load Management	TBD	TBD	TBD		Column applicable to CEC only
109	3rd Triennial (2018-2020)	PG&E	3.43 - Momentary Outage Information	TBD	TBD	TBD		Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	Applicable Metrics	2019 Update
	A	*B*	*C*	*AC*	*AD*
For Report DOC	i. Investment Plan Period		Project Name	vi. Metrics	xv. 2019 Status Update
106	3rd Triennial (2018-2020)	PG&E	3.40 - Advanced Reference Tool	TBD	• Project is currently on hold.
107	3rd Triennial (2018-2020)	PG&E	3.41 - Drone Enablement	TBD	• Project is in planning phase.
108	3rd Triennial (2018-2020)	PG&E	3.42 - Ridesharing Load Management	TBD	• Previously defined as EPIC 2.32. Deferred to EPIC 3 by CPUC Resolution E-4863 8/10/2017. • Project is in planning phase.
109	3rd Triennial (2018-2020)	PG&E	3.43 - Momentary Outage Information	3a - Maintain / Reduce operations and maintenance costs 5a - Outage number, frequency and duration reductions 5d - Public safety improvement and hazard exposure reduction 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)	• Previously defined as EPIC 2.33. Deferred to EPIC 3 by CPUC Res.E 4863 8/10/2017. • Business plan was approved in December 2019. • Project will develop algorithms to identify patterns to predict outages by leveraging momentary outage data which may lead to an imminent failure on assets such as conductors, or insulators, transformers. • Models will also leverage other sources of data such as time of day, location, and weather.

PACIFIC GAS AND ELECTRIC COMPANY

ATTACHMENT C

2019 EPIC ANNUAL REPORT

APPENDIX B

Pacific Gas and Electric Company

EPIC Final Report

Program	*Electric Program Investment Charge (EPIC)*
Project	*EPIC 1.22 – Demonstrate Subtractive Billing With Submetering for EVs to Increase Customer Billing Flexibility*
Reference Name	***EPIC 1.22 EV Submetering*** ***EPIC 1.22 Plug-In Electric Vehicle Submetering Pilot (PEVSP)***
Department	*Customer Energy Solutions*
Executive Sponsor	Vincent Davis
Project Sponsor	Suncheth Bhat, David Almeida
Business Lead	Irene Kang
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Date	November 27, 2019
Version Type	***Final***

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Table of Acronyms

A.	Application
ANSI	American National Standards Institute
CEA	Customer enrollmet agreement
CPUC	California Public Utilities Commission
D.	Decision
DER	Distributed Energy Resource
EPIC	Electric Program Investment Charge
EV	Electric Vehicle
EVSE	Electric Vehicle Service Equipment (charging station)
GHG	Greenhouse Gas
IOU	Investor-Owned Utility
MCOR	Multiple Customer of Record
MDMA	Meter Data Management Agent
MDMS	Meter Data Management System
NEM	Net Energy Metering
PF	Power Factor
PEV	Plug-In Electric Vehicle
PEVSP	Plug-In Electric Vehicle Submetering Pilot
PG&E	Pacific Gas and Electric Company
SCE	Southern California Edison Company
SCOR	Single Customer of Record
SDG&E	San Diego Gas & Electric Company
TD&D	Technology Demonstration and Deployment
TOU	Time-of-Use

1 Executive Summary

This report documents the achievements, highlights, and key learnings of EPIC 1.22 – *Demonstrate Subtractive Billing with Submetering for EVs to Increase Customer Billing Flexibility* as reported in the EPIC Annual Report, also referred to as EPIC 1.22 –EV Submetering or Plug-In Electric Vehicle Submetering Pilot (PEVSP).

Enabling submetering for EVs is an approach to separately meter EV charging load with the goal of saving EV owners money on charging costs while better aligning EV charging with periods of low electricity demand. The technology examined in this report is focused on light-duty passenger vehicles, however, submetering can be applied to other vehicle types and potentially other Distributed Energy Resources (DER).

Subtractive billing paired with submetering utilizes charging data from submeters, embedded in or associated with EV charging stations, and subtracts it from a customer's standard utility bill. Submeters are electronic systems that measure the amount of electricity flowing to a device, which in this case is an EV charging station. This system allows utilities to offer a customer one electric rate for their EV charging, and a different rate for their primary source of load. A more detailed description of subtractive billing is provided in Section 4.1 and in Figure 4-1.

1.1 Issues Addressed

EPIC 1.22 aimed to address the following issues:

- First, most charging locations do not yet have utility revenue-grade submeters installed to collect charging data;
- Second, Investor-Owned Utilities (IOU) do not have the capability to receive third-party submetered data and automatically subtract it from a customer's bill; and
- Third, the strengths and weaknesses of submetering as an approach to EV charging are not well understood.

1.2 Key Objectives

The primary objective of EPIC 1.22 was to demonstrate the use of EV submetering within an Electric Vehicle Service Equipment (EVSE) to provide EV owners access to electricity at a less expensive electric rate—without having to install an additional utility meter to an existing service. In addition, EPIC 1.22 assesses the EV customer demand and benefits of a Plug-In Electric Vehicle (PEV) submetering arrangement, as well as evaluates billing integration costs to enable EV submetering at scale.

1.3 Project Activities, Results and Findings

This report provides details on the methods, findings and lessons learned from five tasks associated with the project:

- Task 1: Identify Service Offerings and Business Processes for participating utilities and the MDMAs and document the data flows involved with submetering (Section 4.1);

- Task 2: Assess Submeter Accuracy by analyzing the electrical accuracy of submeters in the field and via a laboratory study (Section 4.2);
- Task 3: Analyze the Customer Experience via a set of surveys (Section 4.3);
- Task 4: Assess Customer Billing Issues (Section 4.4); and
- Task 5: Estimate the Cost Savings of Submetering (Section 4.5).

1.4 Key Findings and Lessons Learned

The key findings from this project, which draw on studies conducted as part of the California Statewide PEV Submetering Pilot,[1] are as follows:

- Adding equipment from third-party vendors, and creating a more complex data flow path that involves MDMAs, increases the number of failure points and increases likelihood that billing data will be delayed or inaccurate, which also leads to customer dissatisfaction.
- A more reliable network than residential Wi-Fi should be utilized for billing-quality data.
- At least three major categories of accuracy problems were found:
  - **Time Shifting Issues**, which occurred when the timing of a submeter's charging information did not match the timing of the logger or the whole-house bill.
  - **Recording Issues**, which occurred when a submeter did not record an instance of charging.
  - **Magnitude Issues**, which occurred when the magnitude of the charging load recorded by the submeter did not match the magnitude of the charging load recorded by the logger.
- Once customers signed up for the submetering pilot, there was broad satisfaction with the service (see Section 4.3.2), however, this was undercut by the 10% of participants who dropped out before the end of the pilot, usually due to inaccurate or delayed bills, or due to a lack of savings on their electricity bill.
- A survey of EV owners who were not part of the pilot (see Section 4.3.4), conducted in 2016, found that there is strong interest in the concept of submetering if participants could save at least 30% on EV charging costs. The same study also showed that EV owners were far more likely to trust their utility as a provider of charging services as compared to an independent vendor.

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[1] For more information, please see Section 2.2 of this report and the California Public Utilities Commission (CPUC) webpage on Plug-In Electric Vehicle (PEV) Submetering: http://www.cpuc.ca.gov/general.aspx?id=5938.

- A survey of customers with billing issues (see Section 4.3.3), found that 38% of those who complained to PG&E did so because of problems with billing data provided by the MDMAs. An additional 18% of customers in the pilot were frustrated by conflicts between the submetering pilot and other demand response programs that they participate in. Inquiries to other utilities[2] participating in the pilot were driven by confusion over customer enrollment status and by delayed bills caused by unreliable MDMA data transfer to the utilities.
- A study of cost savings performed by an independent evaluation firm as part of the California Statewide PEV Submetering Pilot found that installing a charging station with a submeter saved customers $374 over installing a second utility-grade meter. The major costs for installing a Level 2 charger are the service panel and related wiring and vary greatly by location.
- A study of cost savings performed by an independent evaluation firm as part of the California Statewide PEV Submetering Pilot found that a customer could save $319 per year relative to the tiered rate by enrolling on a whole-house rate for PEV charging without investing in any type of separate metering. $58.79 is the incremental annual savings associated with the separate meter enabled rate. While the results above may represent the average customer in SCE's moderate climate region, they are not specific to PEV owners, who may have different energy use patterns.
- Based on preliminary estimates from the three participating IOUs, the utilities would each have to invest $3,000,000 to $5,000,000 to modify their customer billing systems to integrate submetering data from third-party vendors and generate a subtractive bill for EV charging.
- The approach to subtractive billing tested in this pilot is not yet ready to serve millions of customers across the state of California, given the data accuracy and billing issues experienced.

1.5 Conclusion

In summary, the results of EPIC 1.22 have led PG&E to determine that third-party submeters cannot provide the reliability and data accuracy required for retail billing, and that there is currently no path to production for such a use. This determination is based on the empirical assessment summarized in this report:

- Charging stations with submeters were not sufficiently accurate as demonstrated by both in-field data and independent lab tests.
- The MDMAs were unable to reliably receive data from the EVSE and were unable to transfer billing data to the IOUs in a timely or accurate manner. A more reliable network than residential Wi-Fi should be utilized to transmit charging data. In addition, MDMAs need to

[2] The three utilities who participated in the California Statewide PEV Submetering Pilot were PG&E, SCE, and SDG&E.

demonstrate their ability to reliably manage usage and billing data before this approach can be scaled to serve the state of California.

- The customer benefits in terms of saving on charging equipment are modest when compared to installing a separate utility grade meter and the upgrades required to accommodate third-party submeter data. For many customers, a whole-house TOU electric rate is likely sufficient to produce bill savings, independent of any submetering.

2 Introduction

This report documents the achievements, highlights, and key learnings of EPIC 1.22 – *Demonstrate Subtractive Billing with Submetering for EVs to Increase Customer Billing Flexibility*. This project is also referenced as the Plug-In Electric Vehicle Submetering Pilot (PEVSP) and hereafter as EPIC 1.22 – EV Submetering.

2.1 EPIC Program Regulatory Background

The CPUC passed two decisions that established the basis for the EPIC Program. The CPUC initially issued Decision (D.) 11-12-035, *Decision Establishing Interim Research, Development and Demonstrations and Renewables Program Funding Level,*[3] which established the Electric Program Investment Charge (EPIC) on December 15, 2011. Then, on May 24, 2012, the CPUC issued D.12-05-037, *Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge and Establishing Funding Collections for 2013-2020,*[4] which authorized funding in the areas of applied research and development, Technology Demonstration and Deployment (TD&D), and market facilitation. The CPUC defined TD&D as "the installation and operation of pre-commercial technologies or strategies at a scale sufficiently large and in conditions sufficiently reflective of anticipated actual operating environments to enable appraisal of the operational and performance characteristics and the financial risks associated with a given technology."[5]

The decision also required the EPIC Program Administrators[6] to submit Triennial Investment Plans to cover three-year funding cycles for 2012-2014, 2015-2017, and 2018-2020. On November 1, 2012, in Application (A.) 12-11-003, PG&E filed its first triennial EPIC Application, requesting $49,328,000 including funding for 26 Technology Demonstration and Deployment Projects. On November 14, 2013, in D.13-11-025, the CPUC approved PG&E's EPIC plan, including $49,328,000 for this program category. On May 1, 2014, PG&E filed its second triennial plan for the period of 2015-2017 in EPIC 2 Application (A.14-05-003). CPUC approved this plan in D.15-04-020 on April 15, 2015, including $51,080,200 for 31 TD&D projects.[7]

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[3] http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/156050.PDF.

[4] http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF.

[5] CPUC D.12-05-037, p. 37.

[6] Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), Southern California Edison Company (SCE), and the California Energy Commission (CEC).

[7] In the EPIC 2 Plan Application (A.14-05-003), PG&E originally proposed 30 projects. Per CPUC D.15-04-020 to include an assessment of the use and impact of EV energy flow capabilities, Project 2.03 was split into two projects, resulting in a total of 31 projects.

Pursuant to PG&E's approved 2015-2017 EPIC plan, PG&E initiated, planned and implemented EPIC 1.22 - *EV Submetering* project. Through the annual reporting process, PG&E kept CPUC staff and stakeholders informed of progress. The following is PG&E's final report on this project.

2.2 California Statewide PEV Submetering Pilot Regulatory Background

In July, 2011, the CPUC issued D.11-07-029 which ordered the three major California-based IOUs[8] to develop a protocol to allow submetered usage from EV chargers to be billed separately from the remainder of residential customers' total usage, as measured by the IOU's meter. This is referred to as subtractive billing.[9]

The Decision also stipulated the IOUs may not participate in the EV charging or submetering market.[10] On November 19, 2013, the CPUC issued D.13-11-002 modifying the PEV Submetering Protocol requirements set forth in D.11-07-029 by adopting a CPUC Energy Division staff Plug-In Electric Vehicle Submetering Roadmap for a two-phase pilot. The Statewide PEVSP project was managed by PG&E, but included both SCE and SDG&E as participants. Funded primarily through the EPIC Program, the project started on October 31, 2014 and concluded on September 1, 2018. A third-party evaluation firm conducted the studies for each phase. More information on the regulatory background of the PEV Submetering Program and the related technical reports can be found on the CPUC website: http://www.cpuc.ca.gov/general.aspx?id=5938.

[8] The three California IOUs who participated in the Statewide PEV are Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and San Diego Gas & Electric Company (SDG&E).

[9] Subtractive billing is a process where usage data from a submeter is subtracted from the usage data collected by the utility. This allows the load measured by the submeter to billed separately from the customer's overall bill. Please see Section 4.1 for a diagram and more details on subtractive billing.

[10] See CPUC D.11-07-029 and D.13-11-002, which set the parameters for the Pilot Studies. According to D.13-11-002, IOUs are not permitted to serve as MDMA in Phase 1; however, in Phase 2, this role was opened to the IOUs, although none served in that role.

3 Project Summary

As the adoption of EVs continues to accelerate in California, EV charging patterns will become an increasingly important factor in the state's electricity system. In January 2018, Governor Brown signed Executive Order B-48-18, which sets a goal of 5 million Zero Emissions Vehicles on the road in California by 2030. Next 10, a San Francisco-based think tank, finds that the state will likely meet or exceed the goal, but that charging infrastructure is not "keeping pace" with the rapid growth in EVs.[11]

EVs can provide benefits to the state in the form of lower greenhouse gas (GHG) emissions. However, in a future where EVs make up a significant share of California's vehicle fleet, charging loads will need to be monitored and managed to avoid exacerbating system peaks or negatively impacting grid reliability. Time-of-Use (TOU) pricing of electricity is one effective tool to ensure the bulk of EV charging occurs during periods of low system demand.

Currently, PG&E customers can access EV TOU rates in one of two ways—either by enrolling their entire house or facility onto a TOU rate, or by installing a separate meter dedicated to EV charging. Using submeters embedded in, or associated with, charging stations or other equipment presents a third approach that provides greater flexibility—however, this relatively new technology presents several key issues.

3.1 Issues Addressed

There are several issues addressed in this project. First, most charging locations do not yet have utility revenue-grade submeters to collect charging data. Second, IOUs do not have the capability to receive third-party submetered data and automatically subtract it from a customer's bill. Third, the strengths and weaknesses of submetering as an approach to EV charging are not well understood. This project is intended to address these issues by evaluating the use of submetering data for subtractive billing.

3.2 Objectives

The primary objective of EPIC 1.22 is to demonstrate the use of third-party EV submetering to provide EV owners access to electricity at a less expensive electric rate—without having to install a new separate utility meter for the purpose. In addition, EPIC 1.22 assesses EV customer demand and customer experience with submetering, as well as evaluates billing integration costs to enable EV submetering at scale.

The underlying technical assessment for this report was conducted as part of a two-phase EPIC pilot project managed by the CPUC with the participation of PG&E, SCE, SDG&E and a small group of third-party vendors who supply EV charging stations and related data services. These vendors were collectively called Meter Data Management Agents (MDMA). The *California Statewide PEV Submetering Pilot* was designed to test the implementation of third-party EV submetering solutions via

[11] See Next 10's The Road Ahead for Zero-Emission Vehicles in California for more detailed statistics: http://next10.org/zev.

MDMAs, and to evaluate the customer experience for both residential and commercial customers. A third-party firm with expertise in evaluation conducted the studies and published the final reports.

3.3 Scope of Work and Project Tasks

To meet the above objectives, the underlying pilot study was conducted in two phases. Phase 1 of the pilot, which was a small scale study involving 241 customers (out of a maximum allowed pilot size of 1,500) across California, began in early 2014 and results were published on April 1, 2016 in *the California Statewide PEV Submetering Pilot—Phase 1 Report*. In Phase 1, MDMAs offered charging stations with submeters to customers who were fully responsible (Single Customer of Record or SCOR) for paying all electricity consumption (including the submetered consumption) at their service location.

Phase 2 of the pilot, which included 434 customers across the state, began in early 2017 and results were made public in May 2019 in the *California Statewide PEV Submetering Pilot—Phase 2 Report*.[12] In Phase 2 of the pilot, the main objective was to evaluate the submetering process with a focus on customers who are billed as Multiple Customers of Record (MCOR). MCOR customers often live in multifamily housing or are commercial tenants who sublease.

Due to the timelines of the California Statewide PEV Submetering Pilot and the complexities of getting agreement from the multiple parties required in MCOR situations, MDMAs were unable to enroll any customers of this type, and thus only the SCOR scenario was evaluated in this study. The MDMAs, who were responsible for recruiting customers into the pilot project, reported that it was too complicated and time consuming to find, vet, and sign MCOR customers. According to the Phase 2 evaluation study, the MDMAs stated that gaining approval from the property owner and/or manager, and gathering signatures from MCOR, was too time consuming given the timelines of the pilot project.

Although the Phase 2 study did not include MCOR customers, it did examine a larger group of customers (434 submeters across the state out of a maximum of 1,500). In addition, stakeholders made improvements to the enrollment process, back-end data flow, and evaluation methods.

Table 3-1 summarizes the enrollment in each phase by IOU.

Table 3-1: Enrollment in Phase 1 and Phase 2 Pilot Studies

IOU	Phase 1 Enrollment	Phase 2 Enrollment
PG&E	132	240
SCE	92	151
SDG&E	17	58
Total	241	434

[12] Most of the participants in Phase 2 were new to the study; however a small number also participated in Phase 1. Participants in Phase 2 had to reapply to the program and were not automatically carried over.

Although certain components of these two studies are similar, the Phase 2 evaluation study built off the work done in the Phase 1 study and used improved evaluation methods. The California Statewide PEV Submetering Pilot studies were written by an independent evaluation firm with the participation of the three IOUs. This EPIC report synthesizes findings from the Phase 1 and Phase 2 evaluation reports, which are both available in full from the CPUC Plug-in Electric Vehicle (PEV) Submetering website.

3.4 Tasks and Milestones

To satisfy the objectives of EPIC 1.22, PG&E established the following tasks for this report:

- Task 1: Identify Service Offerings and Business Processes for participating utilities and the MDMAs and document the data flows involved with submetering (Section 4.1).
- Task 2: Assess Submeter Accuracy by analyzing the electrical accuracy of submeters in the field and via a laboratory study (Section 4.2).
- Task 3: Analyze the Customer Experience via a set of surveys (Section 4.3).
- Task 4: Assess Customer Billing Issues (Section 4.4).
- Task 5: Estimate the Cost Savings of Submetering (Section 4.5).

The results for reach task are detailed in the following section.

4 Project Activities, Results, and Findings

The EV submetering study consists of five major tasks as outlined above. This section presents the methods, results and observations, and lessons learned for each of the five tasks. As discussed above, to complete the empirical studies that underlie the analysis in this EPIC 1.22 report, the CPUC and the IOUs retained a third-party independent evaluation firm who conducted the work.

4.1 Task 1: Identify Service Offerings and Business Processes

Because subtractive billing via submetering relies upon a relatively new set of technologies and processes, the project team first identified and described the service offerings and business processes used by the IOUs and MDMAs, and then documented the data flows between the two sets of stakeholders.

4.1.1 Technical Development and Methods

The evaluators reviewed publicly available data on the MDMA service offerings and then conducted qualitative stakeholder interviews with the MDMAs and the participating IOUs. Based on information from these entities, the evaluation firm described the service offerings of the MDMAs, and documented the subtractive billing data flow between the utilities and MDMAs.

4.1.2 Results and Observations

In this project, the IOUs were responsible for processing enrolled customers, setting up separate submeter service accounts, performing subtractive billing for participations, and providing customer support.

To accomplish these tasks, the IOUs worked with a small group of MDMAs, who marketed the pilot to customers, provided charging stations, enrolled customers, and provided data from the submeters, which were either associated with or embedded in the charging stations that they provided to customers.

To enroll, customers were required to fill out a customer enrollment agreement (CEA)[13] with their MDMA who would submit it to the utility. In most cases, customers paid for a licensed professional to install the EVSE with a submeter; in certain locations, the EVSE and submeter could be plugged in and hung on the wall. When the customer charged their EV, the submeter in the charging station tracked the power consumed by the EV and recorded a stream of charging data.

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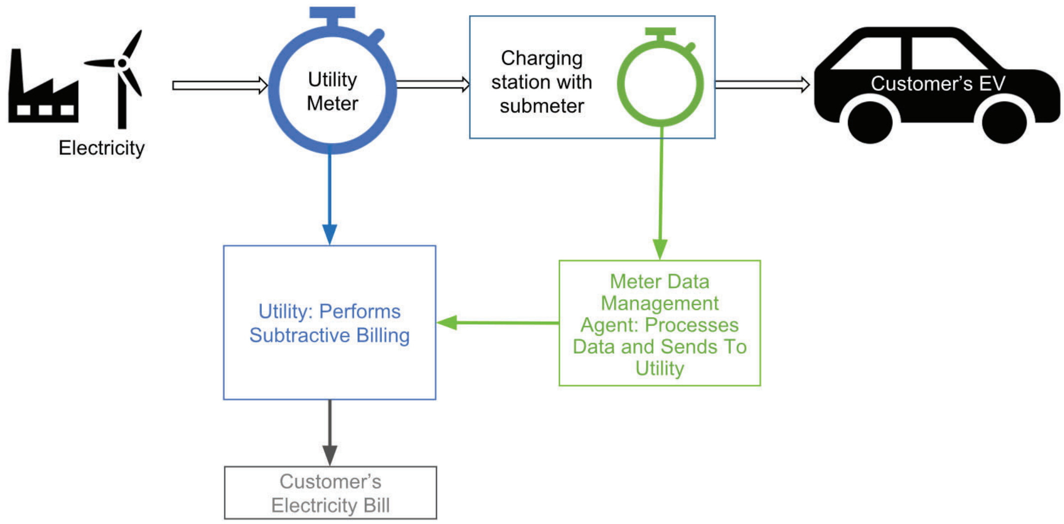
[13] CEAs were similar for each IOU and contained: terms and conditions, a list of eligibility criteria, a description of the duties and obligations of the participant and IOU, and a form to provide information. CEAs could be rejected by the IOU if customers did not meet the eligibility criteria or if the CEA had missing or incorrect information. IOUs often worked directly with customers to resolve issues; in some cases, CEAs with issues were sent to the MDMA for resolution.

Figure 4-1 depicts these relationships for a SCOR who is responsible for paying for all of the electricity consumption at a premises.[14]

Figure 4-1: Activities and Responsibilities for Submetering Stakeholders



The charging station sends data to the MDMA, using the customer's home Wi-Fi network. The MDMA organizes the data and then sends it to the IOU by way of secure electronic file transfer. The IOU uses this data stream, in conjunction with the standard meter data they receive from the customer's utility meter via the SmartMeter™ Network, to calculate a whole-house charge and a separate EV charge. The IOU combines all information into a final bill and sends it to the customer via their standard customer management system.

Participating customers in both phases were primarily residential customers living in a single family home; one exception was in Phase 2 when a condominium homeowner's association (billed at a commercial rate) registered as a multi-family SCOR customer.[15]

4.1.3 Lessons Learned

The number of stakeholders involved in signing up customers to a program increases the likelihood of errors and can decrease customer satisfaction as applicants may not be sure whom to contact regarding a problem. Although stakeholders made improvements over the course of the pilot, the enrollment process sometimes led to confusion and delays in enrollment for customers.

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[14] Master metered premises were not eligible for Phase 1 of the pilot. Additional flow charts depicting the SCOR and MCOR relationships are available in Appendix D of the California Statewide PEV Submetering Report—Phase 2.

[15] The homeowner's association case was not included in the logger-based accuracy study, but was included in the customer surveys and other portions of the study.

In addition, the data transfer process was problematic. Submeter charging data was sometimes delayed, likely due to communication issues between the customer's charging station and the MDMA (See Section 4.2 Task 2: Assess Submeter Accuracy). When billing data from the MDMAs was delayed, this caused customers to miss the benefits of submetered rates, and sometimes led to late bills; both of these factors caused customer dissatisfaction. These delays frustrated customers, as detailed in Task 3: Analyze the Customer Experience.

Overall, the business processes were new and required customization, which led to labor intensiveness and room for error. Task 1 resulted in the outlining of processes and data flows for enabling fully automated participant sign-up, data editing, verification, validation and billing.

4.2 Task 2: Assess Submeter Accuracy

In order for submetering to be successful from both a business and a customer satisfaction perspective, submetering data from the MDMAs must be on-time and accurate so that IOUs can bill customers appropriately. The accuracy of the submeters was evaluated using two different techniques:

- By taking field measurements of customer installations using data loggers; and
- By testing two samples of charging stations from each MDMA in a third-party laboratory setting.

In Phase 1, an accuracy threshold of ±5% was set for the submeters when installed on customer premises. This threshold was the result of negotiations among the stakeholders and was a compromise to allow the development of charging station technology.

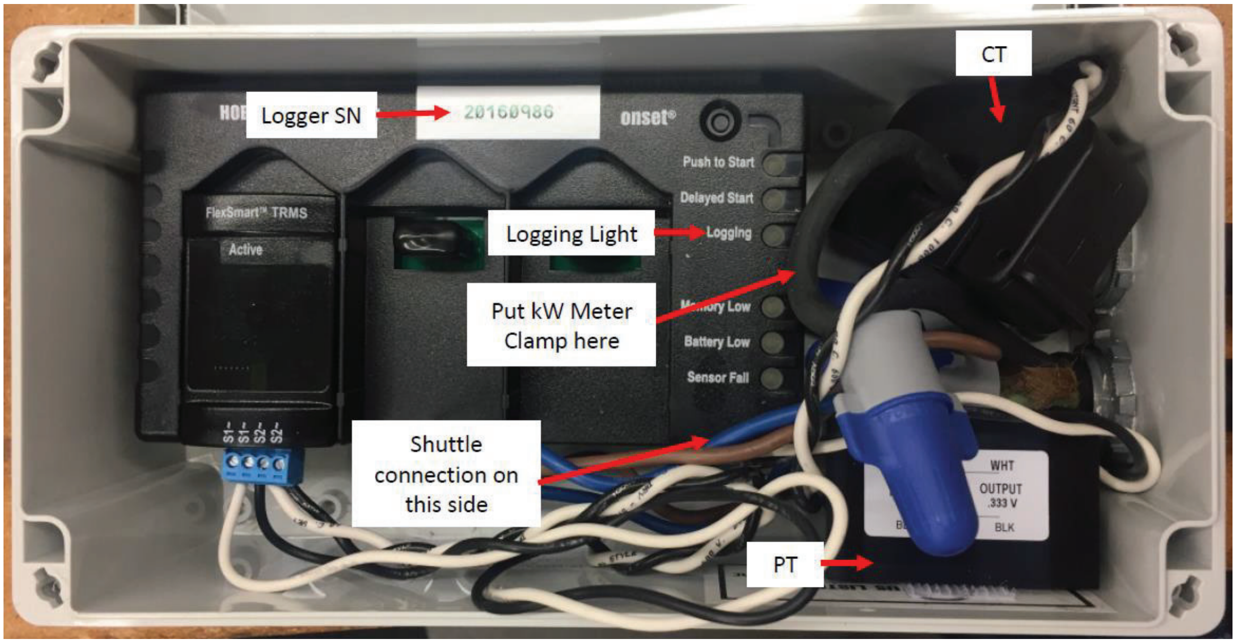
In Phase 2, again based on stakeholder discussions, the submeter accuracy threshold was set to ±2% in the field and ±1% in a laboratory setting. The accuracy threshold was allowed to be less stringent in the field, consistent with the standards set by the American National Standards Institute (ANSI).

For comparison, PG&E utility grade meters must meet an accuracy standard of ANSI C.12.20 class ±2% in the field and ±0.5% in a laboratory setting.

4.2.1 Technical Development and Methods

To carry out the in-field testing, a third-party evaluation firm contacted customers to ask if they would allow loggers to be installed. Using a technical contractor, the evaluators installed loggers on the premises of all 58 customers who replied yes. Loggers are external devices that can measure the electric load on circuits to within ±0.5%. These devices can also assess the timing accuracy of the charging stations. The Phase 2 logger is shown in Figure 4-2; similar devices were used in the Phase 1 study.

Figure 4-2: Example of a Logger



Loggers were installed in the field on a rolling basis (i.e. as soon as possible after recruitment) by field engineers, hired by the evaluator, who have experience with the installation and recovery of data logging equipment. The loggers were put in place for 7-10 days in each location. The evaluators chose this duration to ensure that multiple charge cycles over a given week could be observed at each location.

In Phase 2, loggers were set to record data in 5-minute intervals. This interval was selected to provide greater resolution than the 15-minute intervals that are now standard for the large IOUs' primary meters.

Because the Phase 2 logger study showed that only 5.2% of the charging stations passed the most stringent accuracy threshold of the study, the CPUC and evaluator determined to conduct a laboratory study of the submeters used in the Phase 2 pilot. Six charging stations (two samples from each of the MDMAs) were submitted to a third-party electrical testing laboratory. The lab simulated the charging load of an EV and then precisely measured the electricity flowing through the charging stations. More details on the logger and lab test procedures and protocols can be found in the Phase 1 and Phase 2 PEV technical reports.

4.2.2 Results and Observations – Logger Study

Several statistical techniques were used to generate a range of figures and tables depicting the accuracy issues for both the logger-based study and for the laboratory study. To formally test the similarities between the submeter measurements and logger readings, an equivalence testing approach with a threshold of 2% was used in two distinct ways.

The first was to use a paired t-test approach. A paired t-test is a statistical test used to compare the means of two different samples where observations in one sample are paired with observations in a second sample. This approach consists of two separate tests, one of the null hypothesis that the submeter mean is at least 2% less than the logger mean and the second of the null hypothesis that the submeter mean is at least 2% greater than the logger mean. The results of the equivalence tests for each submeter are shown in Table 4-1.

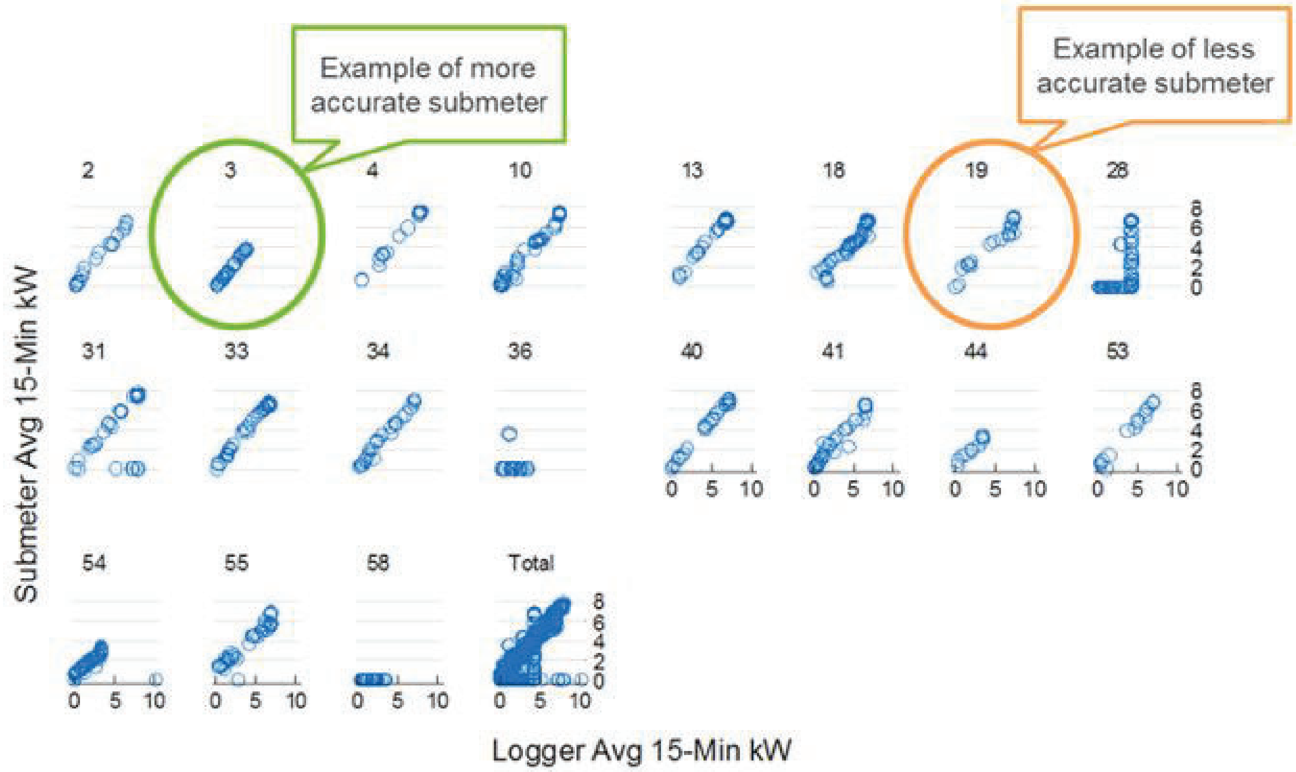
At the 15 minute level, only 5.2% of submeters in Phase 2 study met the most stringent accuracy threshold of ±2%. In order to determine if the submeters were reasonably close to the target, the analysis was repeated using daily consumption levels rather than the 15 minute level. This relaxed constraint allowed for minor deviations between 15-minute intervals to net-out on a daily basis. However, even at the daily level, only 9.6% of submeters in the Phase 2 study were able to stay within the ±2% accuracy threshold.

Table 4-1: Equivalence Testing Results for Submeter Accuracy All Vendors by Utility

	PG&E	SCE	SDG&E	Avg. Pass Rate
Percent customers passing (15-min kw intervals +/- 2%)	15.8%	0.0%	0.0%	5.2%
Percent customers passing (Daily kw intervals +/- 2%)	31.3%	0.0%	0.0%	9.6%

Figure 4-2 shows the comparisons for each submeter in the form of scatter plots for a set of submeters reporting to PG&E. Each 15-minute interval is represented in the figure by a blue circle. When submeters and loggers agree, these graphs will show a straight 45-degree line. Deviations from the 45 degree line represent inaccuracies. The Y-axis in the graphs represent the submeter average 15-minute kW, and the X-axis represents the logger readings for the same time interval.

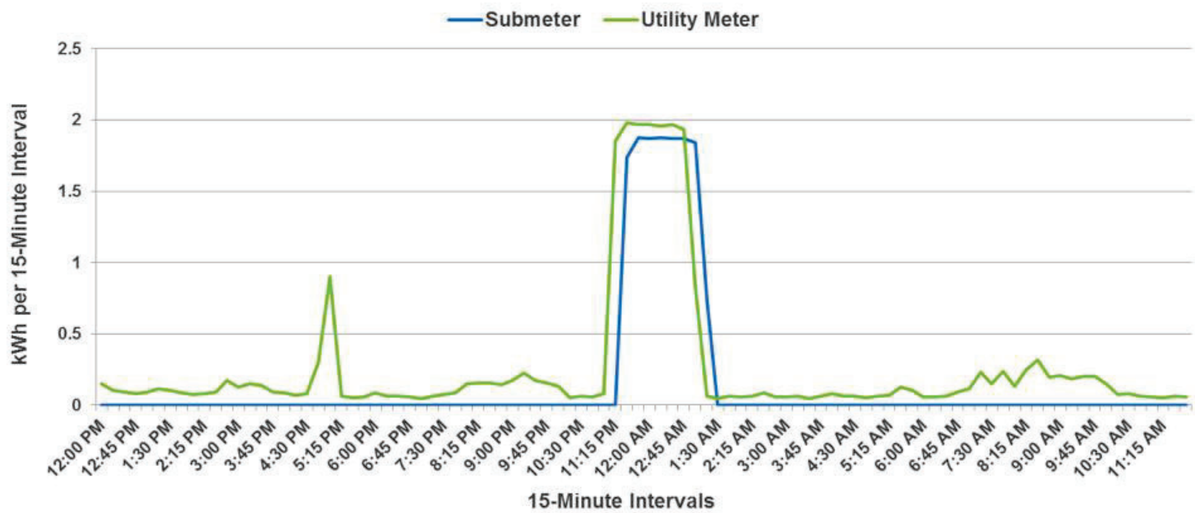
Figure 4-2: Submeter Measurements vs. Logger Readings, Phase 2 Pilot



Given the small percentage of submeters that passed even the less stringent daily accuracy test, the CPUC and evaluator recommended sending two samples of each MDMA's equipment to third-party laboratory testing.

Visualization of time shifting issues is presented in Figure 4-3. This figure visually compares charging load over time as measured by a submeter against the charging load as measured by the utility meter. Figure 4-3 shows the submeter was not time synchronized to the utility meter. This results in a discrepancy between when the utility meter shows charging begins (at approximately 11 p.m.) and when the submeter shows that charging begins (at approximately 11:15 p.m.). Although this issue was fixed, time-synchronization issues are a potential source of submeter inaccuracy.

Figure 4-3: Time Shift in Usage Data Between Submeter and Utility Meter

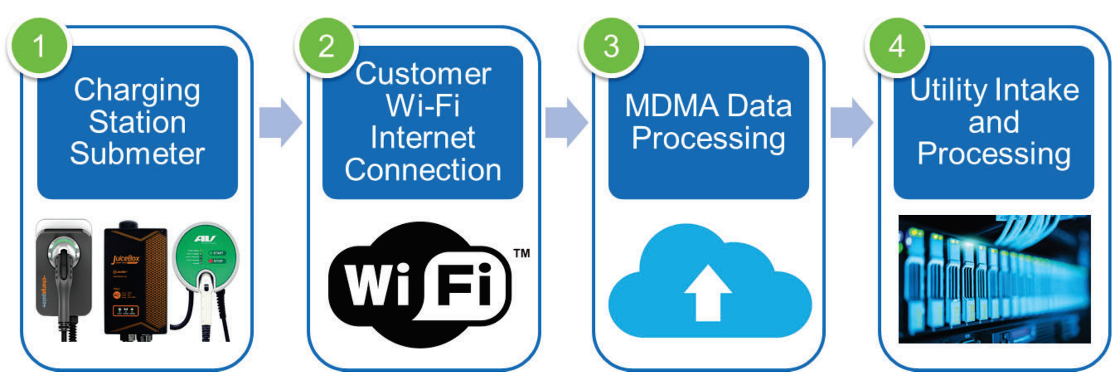


4.2.3 Source of Inaccuracies

Customer Wi-Fi Internet Connection provides a high-level overview of the data flows between the submeter and the utility in order to provide visibility into potential sources of the inaccuracies. The potential sources for inaccuracies are organized by each step in the diagram. The decision to laboratory test the submeters was not part of the original test plan for the project. It came about when the third-party evaluator discovered that the submeters were not meeting the field performance standard (i.e., ±2% error) and brought it to the CPUC's attention.

The tests from the third-party laboratory were carried out to independently to help isolate the sources of inaccuracies. The field testing relied on data that passed through all four steps in Figure 4-4 Although laboratory testing also relied on Wi-Fi, in the lab environment a high quality connection was established to remove this source of failure. Consequently, the laboratory testing was able to identify issues that were contained to steps 1 and 3 of the submeter systems.

Figure 4-4: Data Flow Diagram



4.2.4 Charging Station Submeter

Laboratory testing confirmed accuracy issues remained, even when the complications of customer Wi-Fi and utility data intake were removed. However, the lab testing still relied on retrieving charging data from the MDMA's online portal. This, in turn, required the data to be transmitted to the MDMA's cloud-based system and presumably processed in some way before being transmitted to the online portal.

Without a direct diagnostic output from the charging station, it is impossible to determine with complete certainty if the accuracy issues are from the submeter, data processing and storage, or both. Inclusion of a diagnostics tool in future submeter models, such as a light that blinks after every 1 kWh of electricity consumed may help isolate accuracy issues.

4.2.5 Customer Wi-Fi Internet Connection

The potential intermittency of customer Wi-Fi was another possible source of data issues. Some charging stations may only store a day of data and customer Wi-Fi, in certain circumstances, can become disconnected for a longer period of time. If this occurs, the submeter is not able to send charging data to the MDMA. A lack of charging data can lead to inaccurate customer bills or a loss of savings to the customer if only part of a billing cycle is recorded.

For example, one brand of EVSE charging station had 24 hours of on-charging station data storage, whereas another brand can store up to 90 days of interval data. Based on these on-charging station storage capacities, if the Wi-Fi connection was down for more than 24 hours, there is a potential for data loss.

Based on the evaluator's acuracy analysis, there were instances where the data loggers indicated charging was taking place, but there was not any registered consumption from the submeters. These instances may be indicative of issues that interrupt communication between the charging station and the cloud-based server.

4.2.6 MDMA Data Processing

Another potential failure point is the MDMAs' data processing, storage, and transmission systems. When the evaluator inquired about the MDMAs' internal data flows and handling practices, the MDMAs responded that their internal processes are proprietary. Without insights to the specific data related processes, it is impossible to determine if any of the accuracy issues are a result of data processing errors. During Phase 2, one MDMA and the IOUs encountered systematic data handling and process related challenges which required the MDMA to re-label data intervals from end time to start time and properly set the 15-minute intervals. This issue was resolved and resulted in improved data quality.

4.2.7 Utility Intake and Processing

Once the data was received by the utilities, it was processed with various levels of automation. PG&E provided the evalutor with the original raw data files it received from the MDMAs and the data files merged with PG&E's whole premise consumption data to assist the evaluator in isolating accuracy issues. The evaluator compared the data sets and confirmed that PG&E's data handling processes preserved the integrity of the data provided by the MDMAs.

4.2.8 Results and Observations – Third-Party Laboratory Study

For the laboratory study, two charging stations from each of the MDMAs were sent to an independent third-party laboratory[16] based in the United States. This facility conducted a range of tests using a simulated EV charging load that allowed them to precisely measure the amount of power being sent through the circuits of the charging station and compare this power usage with that of the embedded submeter.

To prepare for the study, a customized test plan was developed by electrical engineers affiliated with the three IOUs and the independent evaluation firm and designed to simulate the conditions that charging stations may face in the field. The tests include varying voltage and Power Factor (PF) with respect to the utility electrical supply to the charging stations, and varying duration of charging cycles for the EVs.

The tests that the laboratory ran included a standard suite of load conditions designed to simulate various load profiles that the device is likely to face in use. The exact tests used are detailed in the appendix of the Phase 2 report.

The standard was set at ±1% for compliance with the acceptance accuracy standard for the bench testing conducted by the independent lab Test results from the independent lab indicate that all three submeters integrated into the three manufacturers charging stations were not in compliance with the ±1% accuracy standard for bench testing. A redacted[17] copy of the report provided by the lab is contained in Appendix G of the Phase 2 report.

The best performing submeter was only compliant on one-third of the tests, and the compliance rate was lower for the other two submeters; the best performing submeter was compliant with the accuracy standard in 14 of the 42 tests conducted on each charging station. Tests were conducted at two (2) load levels, full load and 1% of full load; two (2) levels, unity and 50%, with the exception of one MDMA unit which would not operate at PF levels below 81% at full load. Multiple voltage levels were also used for the range of tests with both high and low load levels and PFs to simulate the widest range of conditions the chargers might operate at in the field. While an insufficient numbers of tests at each load, PF, and voltage were conducted to determine the statistical significance of each of the three manipulated variables on the test results, some patterns were observed.

Table 4-2 below shows the independent lab test results for the charging stations with submeters by vendor. Approximately 54% of all the tests results showed that the submeters would result in

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[16] The independent lab testing was conducted by MET Labs, based out of Baltimore Maryland. Results were provided in a report titled "TEL99908-PGE ALL TESTS USC Rev 1" delivered to the evaluator on November 1, 2018.

[17] The details of the specific test results are confidential. Non-redacted versions were provided to the utilities and CPUC for review. The MDMAs each received a copy of the report where their specific tests were not redacted so they could review their own results.

undercharging customers for energy deliveries by at least 1%, with 29% of the tests meeting the accuracy standard; the remaining 43% of the test results showed registration errors greater than 1% that would overcharge customers for the energy delivered to the charging station.

Table 4-2: Submeter Accuracy Test Results From Independent Lab

Charging Station	% of Tests in Compliance
Vendor A	33% (14 of 42)
Vendor B	4.8% (2 of 42)
Vendor C	26.2% (11 of 42)

4.2.9 Lessons Learned

Based on the field and additional laboratory testing, the submeters included in this pilot did not meet the accuracy standard of ±1% for acceptance testing in the laboratory or ±2% in the field.

Laboratory testing has identified accuracy issues in the submetering system, which includes the submeter and the cloud data processing. Intermittency of customer Wi-Fi appears to be the driver for data intervals where field loggers recorded charging and the submeters did not. The errors resulting from missing submeter data are significantly larger than the errors identified in the laboratory setting that were isolated to the submeter systems.

From a review of the technical reports, PG&E determined that subtractive billing failures were created primarily by three kinds of issues:

- **Time Shifting Issues**, which occurred when the timing of a submeter's charging information did not match the timing of the logger or the whole-house bill;
- **Recording Issues**, which occurred when a submeter did not record an instance of charging; and
- **Magnitude Issues**, which occurred when the magnitude of the charging load recorded by the submeter did not match the magnitude of the charging load recorded by the logger.

The instance of a logger reading greater than its corresponding submeter was most common, followed by the submeter failing to record an instance of charging. In summary, it was found that the submeters tested as part of this demonstration study were not nearly accurate enough to supply dependable revenue-grade billing information—and this outweighs any potential benefit that might accrue to the customer.

Involving an additional third-party in the subtractive billing process (the MDMAs) creates additional potential for data discrepancies that complicates troubleshooting. The pilot conditions present obstacles to scaling subtractive billing to a statewide scale. There is a need to develop submetering accuracy standards, including standards for end-to-end data delivery.

4.3 Task 3: Analyze the Customer Experience

Task 3 presents findings from three surveys administered by the evaluator as part of the Phase 2 study. In general, the customer experience surveys found broad satisfaction with the submetering pilot: 66% of surveyed participants in the Phase 2 pilot reported being extremely satisfied and 26% reported being somewhat satisfied. The majority of satisfied participants said that the ability to pay a lower rate and reduce their electricity bill was the most important reason for satisfaction. The Phase 2 pilot also provided customers up to $400 in incentives in the form of discounted charging stations provided by the MDMAs.

However, 2% reported being somewhat dissatisfied and 2% reported being extremely dissatisfied with inaccurate bills or higher billing costs being the top reasons for dissatisfaction. In addition, 10% (42 participants) withdrew from the Phase 2 pilot after they had started the program, but prior to completion. Ten of those customers completed a survey designed to discover their reasons for leaving the pilot prematurely. Of those who withdrew, 6 said they were dissatisfied with the submetering service, while 3 said they were satisfied and 1 was ambivalent.

The remainder of this section provides greater detail on how Task 3 was accomplished and provides more information from the surveys that were part of this task.

4.3.1 Technical Development and Methods

The respondent's knowledge of submetering and perceptions of the pilot study was assessed using four survey instruments: one that was part of the Phase 1 pilot, and three that were part of the Phase 2 pilot; because the Phase 2 results are more recent and comprehensive, these results are presented first.

All Phase 2 pilot participants were contacted immediately after enrolling in the pilot with a request to complete a participant survey (the Welcome Survey) in June 2017. Participants then received an additional survey request in May 2018 at the end of the pilot (the Post Pilot Survey).

The first survey instrument, the Welcome Survey, consisted of 34 questions. This survey assessed motivations for participating, knowledge of submetering and demographic information. It was sent via email and United States Mail to 434 customers of the three IOUs participating in the pilot, and 372 responded for an 86% response rate. Those who completed the survey received a $25 check. The number of surveys sent and the response rate by IOU is shown in Table 4-3.

Table 4-3: Phase 2 Participant Survey Response Rates by IOU – Welcome Survey

IOU	Surveys Sent	Surveys Completed	Response Rate
PG&E	240	200	83%
SCE	136	125	92%
SDG&E	58	47	81%
Total	**434**	**372**	**86%**

A second survey, The Post Pilot Survey with 29 questions, was sent to those who stayed in the pilot at the end of 12 billing cycles (approximately a year) and followed the same recruitment strategy as the Welcome Survey. This survey went out to 392 pilot project customers and was returned by 314 for an 80% completion rate.

The third survey was the Unenrolled and Prospective Participants Survey, which included 58 questions. This survey went out to two groups of customers: 14 prospective participants (returned by 4 for a 29% response rate) and 20 unenrolled participants (returned by 10 for a 50% response rate).

Additionally, to better understand why customers may have reacted negatively to the submetering pilot experience, a separate survey was sent to customers who either withdrew from the pilot while it was underway (unenrolled participations) or did not complete the enrollment process (prospective participants).

Further details on the design and administration of the survey instruments is contained in Section 3 of the Phase 1 and Phase 2 evaluation reports. The remainder of this section presents the survey results associated with the focus areas described previously.

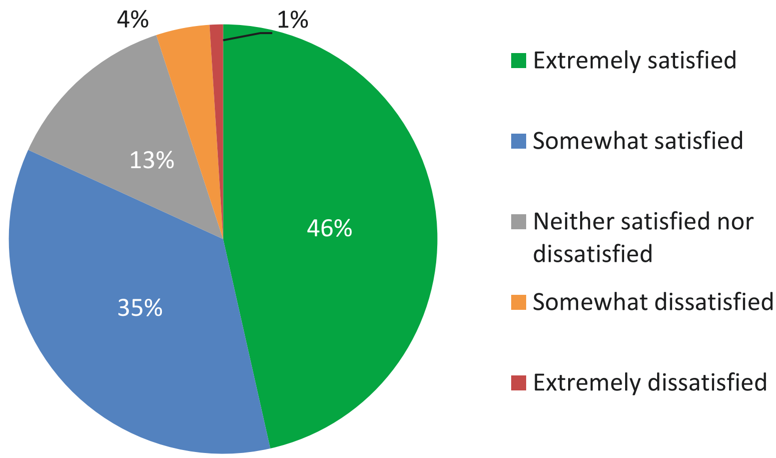
4.3.2 Welcome and Post-Pilot Results

The Welcome and Post Pilot surveys were analyzed together to assess participants' knowledge of behavior around charging their EVs, knowledge of submetering, understanding of the program and of related issues, and experiences with the program. The three most important motivations for enrolling in the Phase 2 pilot were the following:

- Ability to pay a lower rate for electricity used by the PEV;
- The availability of an incentive for the PEV submeter; and
- A discount of approximate $400 on the cost of vehicle charging station.

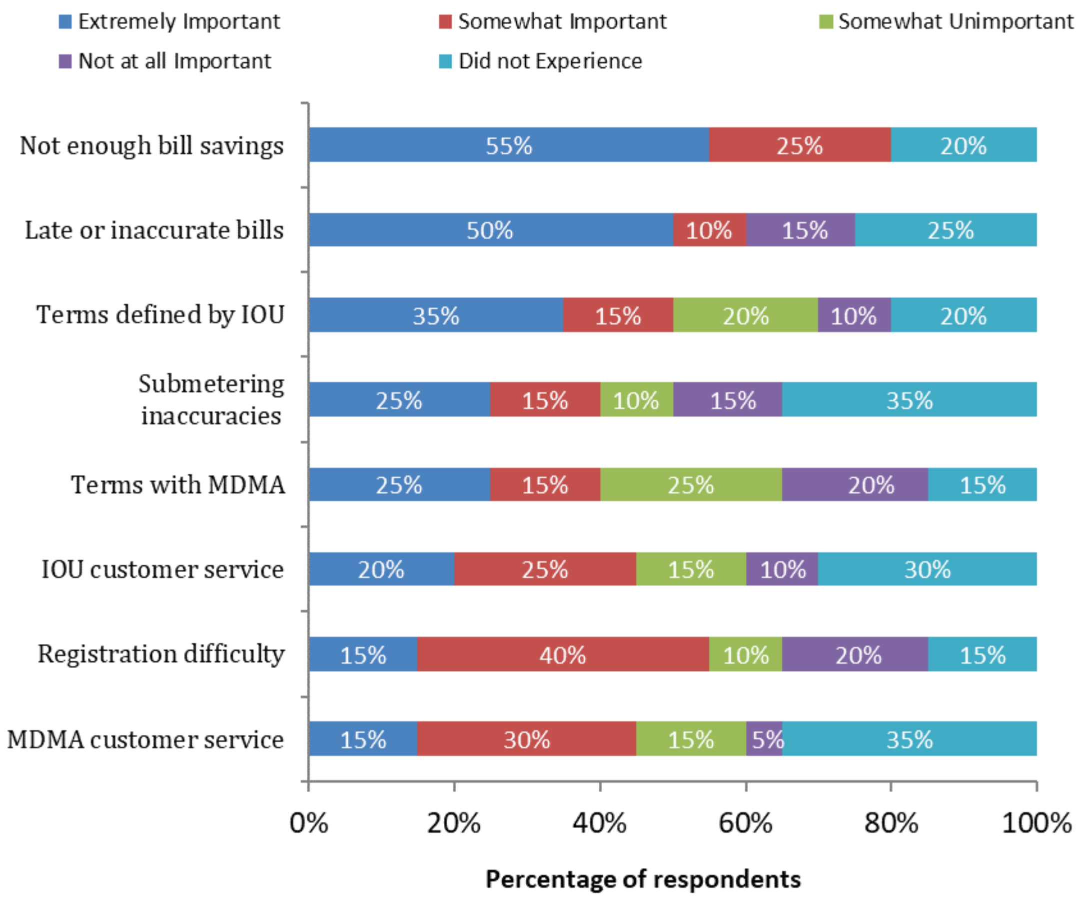
Several questions towards the end of the post-pilot survey dealt with the topic of customer satisfaction in Phase 2. A majority of customers (81%) said that they were "extremely satisfied" or "somewhat satisfied," while 5% of respondents rated their level of satisfaction as "somewhat dissatisfied" or "extremely dissatisfied." The remaining 13% responded as "neither satisfied nor dissatisfied with the program as they had experienced it thus far. Figure 4-5. Presents the frequency of responses:

Figure 4-5: Overall Customer Satisfaction With Submetering Service (Phase 2)



Of the 20 customers who reported being at least somewhat dissatisfied with the pilot, the majority of respondents (55% and 50%) rated "not enough bill savings" and "late or inaccurate bills" as extremely important reasons for their dissatisfaction. Notably, only 15% of respondents rated "Registration difficulty" as extremely important, but 40% rated it somewhat important, leaving registration difficulty to be the third most important reason for dissatisfaction as measured by those who rated it at least. A breakdown of the reasons for dissatisfaction is presented below in Figure 4-6.

Figure 4-6: Reasons for Dissatisfaction With the Phase 2 Pilot



4.3.3 Unenrolled and Prospective Study Results

Forty-two participants who unenrolled from the Phase 2 pilot prior to its conclusion were contacted. Of those who unenrolled, 60% were at least somewhat dissatisfied with their submetering service, while 30% were at least somewhat satisfied, and 10% were ambivalent.

Of the 10 customers who completed the unenrolled survey from Phase 2 of the Pilot, the majority of respondents (60%) rated “not enough bill savings” as an extremely important reason for their decision to un-enroll, and another 20% rated it as somewhat important for a top-2 box score of 80%.

The second most important driver of unenrollment is “Other billing problems” with a top-2 box score of 50% and the third most important driver is “Errors resulting from submeter accuracy” with a top-2 box score of 40%. A breakdown of the reasons for un-enrollment is presented below in Table 4-4.

Table 4-4: Importance of Factors in Deciding to Unenroll From the Pilot (Phase 2)

How important was each of the following aspects in contributing to your un-enrollment from the pilot?	Not Important at All	Somewhat Unimportant	Somewhat Important	Extremely Important	Top 2 Boxes
Not enough bill savings	0%	10%	20%	60%	80%
Other billing problems	13%	0%	0%	50%	50%
Errors resulting from submeter accuracy	10%	0%	0%	40%	40%
Late or inaccurate bills	10%	10%	10%	30%	40%
IOU customer service	30%	0%	20%	20%	40%
MDMA customer service	20%	0%	20%	10%	30%
Other technical problems	14%	0%	0%	29%	29%
Other non-technical or billing problems	0%	0%	0%	17%	17%
No longer have an EV	10%	0%	0%	0%	0%

A total of four customers did not complete the enrollment process while another 63 did not sign a CEA. A breakdown of reasons provided for not completing, or starting (in the case of those that did not sign a CEA), the enrollment process is provided in Table 4-5. The write-in response (e.g., the respondent selected "Other (please explain)" for their reason) has the largest Top-2 box score of 72%. The second most important reason was "The enrollment process was complicated" as indicated by its Top-2 Box score of 69%. The third most important was "I didn't think I would save enough with the rate offered" which has a Top-2 box score of 57%.

Table 4-5: Reasons for Not Completing or Beginning the Enrollment Process (Phase 2)

How important was each of the following aspects in your not completing enrollment for the pilot?	Not Important at All	Somewhat Unimportant	Somewhat Important	Extremely Important	Top 2 Boxes
Other (please explain)	28%	0%	0%	72%	72%
The enrollment process was complicated	21%	10%	48%	21%	69%
I didn't think I would save enough with the rate offered	27%	16%	30%	27%	57%
I would have wanted to stay on the rate for more than 12 months	45%	19%	22%	13%	36%
I didn't want to limit my charging on weekday afternoons / evenings	52%	18%	22%	7%	30%
I didn't think the rate was compatible with my net metered PV solar production	60%	13%	10%	16%	27%
I didn't want to or couldn't un-enroll from other programs (auto-pay, demand response, etc.)	54%	21%	7%	18%	25%
I didn't qualify for the pilot for another reason (please explain)	68%	13%	6%	13%	19%
I don't usually charge my car at home	73%	16%	6%	4%	10%

Table 4-6 provides more detail on what respondents wrote if they selected "Other (please explain)" on the survey. For those who provided details, the most common explanation was that the customer did not want one of the qualifying charging stations, while the second-most common reason was the risk of not qualifying for the project and thus not gaining the incentive, but having to purchase a charging station nonetheless. Another three respondents expressed concern with the cost of the eligible EVSEs.

Table 4-6: Stated Reasons for Not Completing Enrollment

Reason	Count
Did not want qualifying charging station	5
Risk of not qualifying	3
Cost of eligible charging station	3
Missed deadline	2
Already on TOU rate	1
Couldn't use existing charging station	1
External cost factor	1
Net metering conflict	1

4.3.4 Non-Pilot EV Owners Study

Drawing off a study carried out as part of the Phase 1 pilot project, over 8,000 residential EV users who were not part of the pilot project and who lived across California were asked to participate in a survey about submetering. The survey ran in February and March of 2016 and ultimately included responses from about 200 PG&E customers (and 626 in total).

This study found that 41% of PEV owners said they would be willing to enroll in a submetering system similar to that in the Phase 1 pilot that provided substantial savings of approximately 30% on the cost of electricity for EV charging. It is important to note that this figure likely suffers from "hypothetical bias" that often exists with stated preference surveys. Hypothetical bias is generally positive, meaning that survey respondents would be prone to overstate their true likelihood of enrolling in submetering. The earliest adopters of EVs may also be more willing to adopt a submeter than a broader population due to their "first-mover" nature.

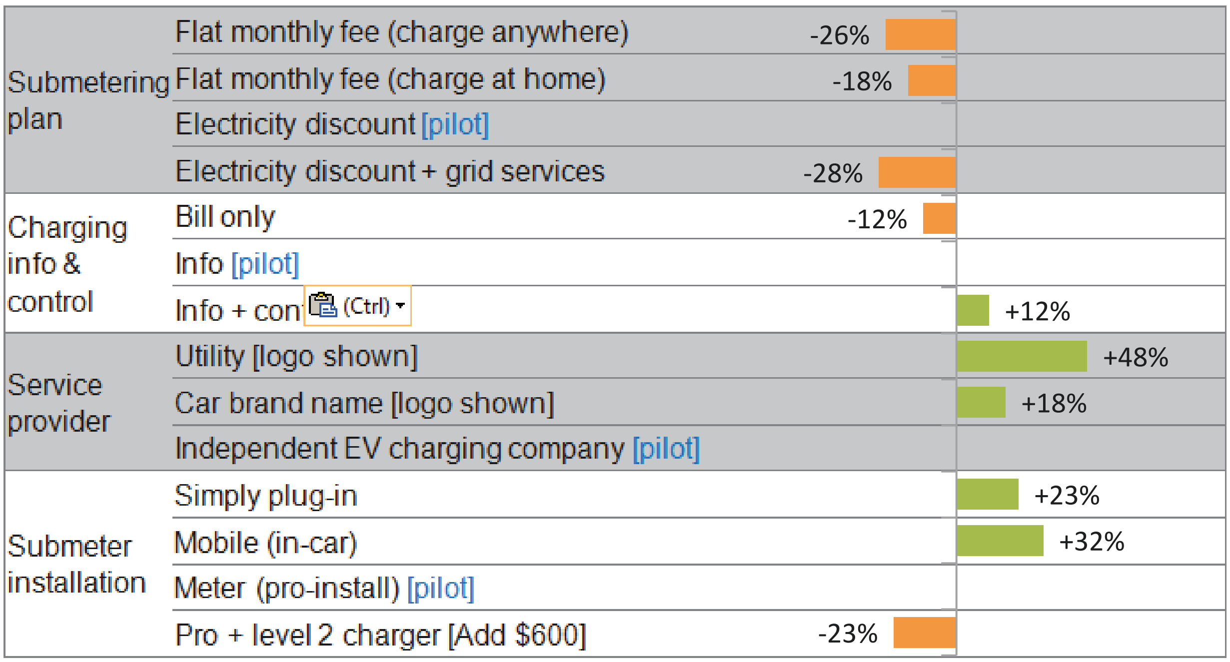
The most important factors driving customer interest in submetering include the business model of the submetering plan, the amount of charging savings, and saving money on the purchase and installation of a home charging station.

The contingent survey design allows the marginal effect of different attributes relating to participant experience to be tested. Figure 4-7 summarizes these attributes and levels along with the modeled relative enrollment impact each level would have compared to the corresponding levels of a prototypical submetering similar to Phase 1.

The submetering plan attribute was intended to test the openness of EV owners to different possible submetering business models. In particular, it tested a flat monthly charging fee—which may or may not include charging on a network of public chargers for no extra cost—and a discounted rate that may or may not include a higher discount in return grid services through demand response.

Before answering these questions, respondents were carefully educated on the concept of grid services before the conjoint and an option was only included for respondents who indicated they might consider it. The Phase 1 submetering plan, which simply includes access to a discounted rate, was largely preferred. However, the preference against the other submetering models was small enough that it could be addressed by designing a plan with other more desirable options to counterbalance the enrollment impacts.

Figure 4-7: Relative Impact on Enrollment Compared to Phase 1 Pilot: Business Model and Participant Experience Attributes



4.4 Task 4: Assess Customer Billing Issues

Inquiries that were made by customers to each of the IOUs for various kinds of help with issues pertaining to billing and the program in general were compiled and analyzed in order to further assess the customer experience, in Task 4.

4.4.1 Technical Development and Methods

This analysis is based on a request for billing inquiry data that was sent to each of the IOUs. Each of the IOUs tracked the received customer support inquiries that related to the submetering pilot project and then reported the findings to the evaluation firm in charge of drafting the California Statewide PEV Submetering Pilot reports.

4.4.2 Results and Observations

Each IOU tracked and categorized data differently; separate tables are provided for each utility. Customer inquiries received by PG&E (excludes unenrollment requests) are shown in Table 4-7. Issues with MDMA data, questions created by enrollment in a conflicting Demand Response program, and general inquiries to better understand the program were the most common inquiries.

Table 4-7: PG&E Customer Inquiries

PG&E Customer Inquiries	
Category	**Percent**
Issue with MDMA data (no or bad data)	38%
Customer enrolled in prohibited program (Rule 24, AP, BPP)	18%
Program clarity	10%
Customer satisfaction	8%
Communications	5%
Customer enrollment documentation incorrect or incomplete	5%
Customer issue	5%
PG&E process	5%
Technology Issue	5%
Total	**100%**

Note: Category percentages may not total 100% due to rounding.

The most common inquiries to SCE were for program enrollment status, general rate, and questions or complaints about late bills. The top sources of SCE customer inquiries related to the program are shown in Table 4-8.

Table 4-8: SCE Total Customer Inquiries

SCE Customer Inquiries		
Category	**Count**	**Percent**
Enrollment Status	31	46%
General Rate Info	10	15%
Delayed Bill	6	9%
Bill Accuracy	5	7%
Request to Change Rate	3	4%
Pilot Info	2	3%
Moving	2	3%
NEM Info	2	3%
General Info	2	3%
Eligibility	1	1%
View Bill Online	1	1%
Hardware	1	1%
Rebate	1	1%
Online Data Availability	1	1%
TOTAL	**68**	**100%**

Table 4-9 shows the customer inquiries received by SDG&E. The most common inquiries were requests to opt-out of the program; customers also made rate inquiries and general program inquiries. In total SDG&E, which is the smallest of the three utilities, received the fewest number of inquiries (9) about the pilot.

Table 4-9: SDG&E Rate Inquiries

SDG&E Customer Inquiries		
Category (Evaluator's Classification)	**Count**	**Percent**
Request to Opt-Out of Pilot Program	3	33%
Rate Inquiry	2	22%
General Program Inquiry	2	22%
Customer Enrolled in Prohibited Program (Rule 24, AP, BPP)	1	11%
Already Enrolled in TOU Rate	1	11%
Total	**9**	**100%**

4.5 Cost Estimates of Submetering

The cost of submetering for customers, MDMAs, and utilities is a critical area to analyze in any broader consideration of policy choices. This section presents cost comparisons of two approaches: Submetering using an EV charging station and installing a separate utility grade meter for EV charging. This section also presents preliminary cost estimates of upgrading utility infrastructure to provide submetering at state-wide scale. Without broader field and customer testing and commercial acquisition, PG&E is unable to provide any definitive cost estimates to deploy submetering for EV charging to existing EV customers or on a systemwide basis. The utilities provided a preliminary range of unit cost estimates for qualitative comparison of utility and third-party submetering costs based on available data, but the range of cost estimates is not credible for use in developing actual deployment cost estimates.

4.5.1 Customer Equipment Cost Estimates: Utility-Grade Meter vs. Charging Station With Submeter

One key motivation for submetering is to lower the cost of installing EV charging equipment to encourage the adoption of EVs. This section compares the costs of installing an EV charging station with a submeter against the main alternative: installing a second utility grade meter dedicated to EV charging.

To carry out this task, the evaluator requested cost estimates from the utilities on installing a second utility-grade meter. The evaluators then researched publicly available information to check the utility estimates. In addition, the evaluators used utility information and public information to generate estimates on the cost of installing an EV charging station with a submeter. They then created a cost comparison between these two approaches.

There are many possible configurations of charging equipment that can be installed at customer's premises.[18] It is important to note that most EVs contain the actual charging equipment within the vehicle. The charging stations discussed in this report provide greater convenience and additional services, such as the ability to remotely monitor or control EV charging—however, they are not strictly necessary.

The evaluators created multiple scenarios that are simplified here to compare these costs:

- Service Model 1: Installing a second utility grade meter and directly charging the EV
- Service Model 2: Installing a networked charging stations with embedded submeter

In both models, the evaluators assumed that the customer is starting with no existing PEV charging-related infrastructure or equipment. In either case, the primary costs to the customer include the labor, materials, and permits to install an additional circuit and associated equipment to connect the meter or charger to the electricity system within the premise. In the second scenario there are additional costs to install the charging station itself.

These costs can vary significantly based on location and the existing electrical configuration at a customer's premises. For example, labor costs are significantly higher in the San Francisco Bay Area as compared to the central valley. The configuration and location of existing wiring relative to the desired charging location can add significant differences to the cost as well. A range of costs is generated in the underlying technical reports, but, for the sake of simplicity, the average costs are presented in this report.

The IOUs estimate that the average cost to the customer under Service Model 1 is approximately $1,640. However, the cost could be lower than this estimate if the customer has existing wiring[19] or the cost could be significantly higher if, for instance, there is a detached garage distant from the main panel which would require trenching. The utilities stated they are aware of installation costs as high as $8,000 in extreme cases.

Service Model 2 includes all of the costs of a new circuit, but also includes the cost of purchasing and installing a networked charging station with submetering capability. The average cost for a charging station with integrated submeter in this pilot was $650 retail. Prices in the pilot ranged from $500 to $850 based on the brand and features.[20]

- The cost estimate of Service Model 1 (separate utility revenue grade meter) is $1,640

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[18] See Section 4.6 of the California Statewide PEV Submetering Pilot – Phase 2 Report, which provides details on scenarios, and assumptions used in the cost estimates. The report will be available on the CPUC's website: http://www.cpuc.ca.gov/general.aspx?id=5938.

[19] An example would be if there was an existing 240V circuit to the garage not being used.

[20] Please see Section 4.6.2 of the Phase 2 report.

- The cost estimate of Service Model 2 (charging station with submeter) is $1,266
- This results in a cost difference of $374

Both installations require the addition of a circuit from either the primary or secondary panel to the charging location.[21] The primary difference between the two options is that installing a separate utility-grade meter requires the addition of a new panel and associated installation costs, whereas the submeter approach requires the purchase and installation of a charging station with an integrated submeter. From the customer's perspective, the charging station with submetering capabilities from Service Model 2 is generally the lower cost option.

4.5.2 Utility Cost Estimates: System Upgrades to Scale Submetering

Installing a utility-grade meter to separately meter PEV charging creates costs for the utility. These include the cost of the meter and any utility costs to install and maintain the second meter. The combined meter and labor costs ranged from $120 to $388, with an average cost of $219. Under the separate utility revenue-grade meter scenario the utilities already have billing systems and processes in place, so there are no incremental system costs to the utility.

Scaling third-party submetering to a state-wide scale also creates costs for the utility. The cost data presented below represents preliminary estimates created by the evaluation firm. Without broader field and customer testing and commercial acquisition, PG&E is unable to provide any definitive estimates of the costs to deploy submetering for EV charging to existing EV customers or on a systemwide basis.

Table 4-10 presents the one-time and recurring costs that are expected to be incurred by the utilities to achieve full-scale automated billing operations incorporating third-party submeter data. The average one-time cost per utility is approximately $4,200,000 and the expected annual recurring cost per submeter is approximately $200. The following sections provide the underlying details that were used to develop the estimates for the customer and utility perspectives.

Table 4-10: One-Time & Recurring Utility Cost of Submetering at Full Scale With Automation

Cost Type:	Cost Component	Average	Range
One-Time / Per Utility	Cost to Establish Protocols	$357,500	$215,000 to $500,000
	Updating Systems for Full Billing/Data Automation	$3,833,333	$3,000,000 to $4,500,000
	Total One-Time Cost to Utility	**$4,190,833**	**$3,215,000 to $5,000,000**
	Operations & Administration Labor Costs Per Submeter	$198	$50 to $346

[21] SCE recently implemented the Charge Ready Home Installation Rebate Program where residential customers can receive a rebate of up to $1,500 toward their out-of-pocket costs for the electrical upgrades and permitting fees necessary to allow installation of a Level 2 (240-volt) PEV charging station. The rebate does not cover the cost of the charging stations, but it will help cover the cost of installing and permitting the charging station.

Recurring / Per Submeter	**Total Annual Recurring Cost to Utility Per Submeter**	**$198**	**$50 to $346**

Utility costs fall within two categories: one-time costs, and annual recurring costs. The one-time costs include establishing the submetering protocols and updating the billing systems for third-party submeter data integration. Annual recurring costs include administrative labor costs to operate the program, address customer inquiries, and rebill customers for missing or incomplete data.

To establish the submeter protocols, each utility expects to incur costs ranging from $215,000 to $500,000. These costs include time for internal staff, stakeholder workshops, and potentially the need to hire external consultants to provide subject matter expertise. Cost estimates to update the data and billing systems range from $3,000,000 to $4,500,000 per utility.

These costs include but are not limited to:

- Establishing MDMA-accessible folder structures;
- Creating appropriate codes to identify the MDMAs, manufacturer and model codes, and meter type codes within the utility server infrastructure;
- Creating gateway for the Meter Data Management System (MDMS) to take in a flat file of interval usage data from the MDMAs;
- Developing processes for collecting the MDMA data and moving to a staging folder for aggregation and processing;
- Creating a new interface program that will pick up the MDMA-Reported Interval Data from the staging folder and review the data for acceptance or rejection;
- Transferring records passing validations to the MDMS gateway for consumption by the MDMS;
- Performing administrative tasks in support of the new submeters and validation, estimation, and editing rules;
- Developing and implementing enrollment and un-enrollment automation tasks;
- Developing rules for Net Energy Metering (NEM) billing; and
- Reconciling direct access and community choice aggregation processes within the billing system.

Several factors may affect the accuracy of the cost estimates that include but are not limited to:

- Protocols[22] That Establish the Data Standards: without issues such as data quality, format, and delivery frequency agreed upon, it leaves uncertainty regarding the design needs, and subsequent costs, for the system.
- Data quality From MDMAs: automation upgrades can be implemented, but they do not resolve the problem of inaccurate metering and MDMA data processing. If submeter energy usage continued to be inaccurate, that would result in a variety of customer complaints and costly resolution steps when scaled across all of a utility's systems (billing, call center, etc.).
- Timing: SCE and SDG&E are undergoing major billing system upgrades over the next few years. The timing of implementing the automation may affect the cost of the project due to the uncertainty related to costs expected several years out under systems that have not yet been implemented.

[22] A protocol could increase or decrease utility costs. SDG&E is currently more automated than the other utilities. If a protocol resulted in a different data format compared to what they currently use, they would incur costs to change their system to accept a different format.

- Potential Requirements for Inclusion Of Customer Facing Applications Like MyEnergy, FirstFuel, and Opower, or Rate Analysis Tools: Requirements for customer facing applications have not been established, and will add cost if they must be implemented.

The annual recurring costs varied significantly by utility. Estimates for these costs ranged from $50 per submeter up to nearly $350 per submeter per year. These costs include the utility program staff that will operate the program, along with charges for time from the billing and call center staff that will be supporting the operations. The variation in these costs may be attributable to how costs are allocated across organizations within a utility, the number of participating customers, and underlying assumptions regarding the frequency and type of interactions with customers. Data quality from the MDMAs, the need for customer facing applications, and the division of labor between MDMAs and utilities from a customer service perspective will also heavily influence the costs.

5 Value Proposition

The purpose of EPIC funding is to support investments in technology demonstration and deployment projects that benefit the electricity customers of PG&E, SDG&E and SCE. The primary objective of EPIC 1.22 is to demonstrate the use of EV submetering to provide EV owners access to lower cost electric rates—without having to install a new separately metered service. From a review of the independent technical reports associated with the California Statewide PEV Submetering Pilot project, PG&E finds that this is not a valid approach to monitoring or managing EV load and that third-party submetering does not provide substantial benefits to end users under the pilot conditions. Thus, the value proposition of this pilot was demonstrating that there is not presently a path to production for third-party submetering within charging stations.

5.1 Primary Principles

The primary principles of EPIC are to invest in technologies and approaches that provide benefits to electric ratepayers by promoting greater reliability, lower costs and increased safety. This EPIC project contributed to these primary principles in the following ways:

- **Greater Reliability**: Subtractive billing via third-party submetering has the potential to improve the monitoring and management of EV charging load, which can contribute to improved system reliability. However, EPIC 1.22 has shown that the demonstrated approach to EV submetering is not ready to scale to the entire state and thus these reliability benefits are not yet able to be realized.
- **Lower Costs:** The successful use of EV submetering via charging stations could reduce the cost of EV charging, however the costs savings—an average of $374 per installation—are modest as compared to installing a second utility-grade meter and may not produce any ongoing bill savings when compared to alternative TOU rates. At the same time, to scale submetering to customers across California will cost the utilities from $3,215,000 to $5,000,000 per utility.
- **Increased Safety**: EPIC 1.22 did not examine this issue.

5.2 Secondary Principles

EPIC also has a set of complementary secondary principles. This EPIC project contributes to the secondary principles of testing societal benefits and GHG reduction potential of new technologies by demonstrating that third-party submetering is not yet ready for statewide scale. However, PG&E supports the goal of making EV charging cheaper and easier. Creating a system that incentivizes EV charging could have the following benefits:

- Societal Benefits: The ability to cost-effectively submeter EVs could reduce the cost of EV charging and/or support the grid by charging off-peak. By making charging cheaper and easier, submetering could support state goals and objectives for EV utilization.
- GHG Emissions Reduction: Reducing the cost of EV ownership and/or charging could increase EV utilization, in turn reducing GHG emissions from fossil fuel vehicles.

5.3 Key Accomplishments

The key accomplishment of EPIC 1.22 is the determination that there is currently no path to production for third-party submetering under the project conditions. As outlined in Section 4, this approach to EV charging and submetering is error prone, complex, does not produce consistent savings for customers, and imposes costs on the ratepayers to change existing billing systems.

However, this finding does provide value to IOUs, ratepayers, and EV owners by demonstrating that proceeding with development of a third-party approach to EV submetering is not an effective course of action at this time and is not economically efficient. This finding may spur additional innovation within the EV charging space or collaboration with utilities to determine a path forward if customer demand necessitates.

Future innovation can build upon the accomplishments of EPIC 1.22, including the establishment of subtractive billing processes and the learnings around the challenges of integrating submetered data into IOU billing systems.

5.4 Key Recommendations

Given the modest cost savings for individual customers, and the high costs that third-party submetering creates for ratepayers, PG&E recommends that the IOUs and associated stakeholders:

- Examine alternative approaches to submetering that use different equipment and/or communications networks, as this study has shown that the demonstrated approach is error-prone.
- Perform additional studies to compare the costs and benefits of EV submetering against whole-house TOU rates. Given that most utilities in California are transitioning to TOU rates in the coming year or two, further analysis of how TOU rates affect EV charging is recommended.
- Develop standards for submeter accuracy, data transmission, and integration into utility billing systems in order to enable a path to production.

5.5 Technology Transfer Plan

A primary benefit of the EPIC program is the technology and knowledge sharing that occurs both internally within PG&E, and externally across other IOUs, the CEC and the industry. In order to facilitate this knowledge sharing, PG&E will share the results of this project in industry workshops and through public reports published on the PG&E website.

On June 24, 2019, the CPUC hosted a public PEV Submetering Workshop where results of this pilot were presented.

5.6 Adaptability to Other Utilities and Industry

This project was a joint California IOU effort and the findings of this project are relevant and adaptable to other utilities and the industry. The key finding, that submetering using third-party vendors is not yet ready for statewide scale, has several potential lessons for other utilities or locations that are considering this approach. As discussed above, the key points are that any future efforts in this direction should:

- Be based on submetering equipment that meets revenue-grade accuracy standards
- Utilize a robust communication standard that can withstand interruptions
- Include proper data verification and validation procedures to ensure the accuracy of subtractive billing

5.7 Data Access

Upon request, PG&E will provide access to data collected that is consistent with the CPUC's data access requirements for EPIC data and results.

6 Metrics

The following metrics were identified for this project and included in PG&E's EPIC Annual Report as potential metrics to measure project benefits at full scale.[23] Given the proof of concept nature of this EPIC project, these metrics are forward looking.

Table 6-1: List of Proposed Metrics and Potential Areas of Measurement (as applicable to a specific project or investment area)	Reference
1. Potential energy and cost savings	
h. Customer bill savings (dollars saved)	Section 4.5.4
4. Environmental benefits	
a. GHG emissions reductions (MMTCO2e)	Section 3

[23] 2015 PG&E EPIC Annual Report. Feb 29, 2016. http://www.pge.com/includes/docs/pdfs/about/environment/epic/EPICAnnualReportAttachmentA.pdf.

7 Conclusion

This report documented the achievements, highlights, and key learnings of EPIC 1.22 – *Demonstrate Subtractive Billing with Submetering for EVs to Increase Customer Billing Flexibility*. Based on the results of the tasks summarized in this report, PG&E has found that there is currently no path to production for third-party submeters embedded within EV charging stations.

Four primary findings from this project drive this conclusion:

- Charging stations with submeters were not sufficiently accurate as demonstrated by both in-field data and independent lab tests. Until hardware is available that meets PG&E's revenue-grade metering standards for accuracy, subtractive billing based on submetering cannot be deployed.
- The MDMAs were unable to reliably receive data from the EVSE and were unable to transfer billing data to the utilities in a timely or accurate manner. A more reliable network than residential Wi-Fi should be utilized to transmit charging data. In addition, MDMAs need to demonstrate their ability to reliably manage usage and billing data before this approach can be scaled to serve the state of California. In order to enable a path to production, PG&E recommends that stakeholders develop standards for submeter accuracy, data transmission, and integration into utility billing systems.
- The customer saves an average of $374 in one-time installation costs to separately meter their EV load. The average customer can save $378 a year on their bill by moving from a tiered rate to a separately metered rate. $319 of the annual savings could be realized by switching from a tiered rate to a whole-house TOU rate without installing a separate meter or submeter.
- The evaluator found that each of the three major IOUs would have to spend $3,215,000 to $5,000,000 on upgrades required to accommodate third-party submeter data, depending on the utility's system configuration. If the state desires alternative methods of calculating GHG credits for EV drivers, PG&E can help deliver such methods without revenue grade billing data. If the state wishes to enable customers to measure their EV charging loads with revenue grade accuracy, PG&E can develop a technology deployment plan to address such a desire, assuming there is sufficient customer demand.

PG&E is eager to continue supporting transportation electrification across the state and rising to meet both the needs of the state and PG&E's customers. PG&E will continue to do so in such a way that appropriately pairs a technology solution with the need it is designed to address. Cost, accuracy, and customer satisfaction are paramount to right-sizing these solutions.