

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

Application of Pacific Gas and Electric Company (U 39 M), San Diego Gas & Electric Company (U 902 E), and Southern California Edison Company (U 338 E) for Authority to Increase Electric Rates and Charges to Recover Costs of Research and Development Agreement with Lawrence Livermore National Laboratory for 21st Century Energy Systems

A.11-07-008
(Filed July 18, 2011)

**OPENING BRIEF OF PACIFIC GAS AND ELECTRIC
COMPANY (PG&E) (U 39 M), SAN DIEGO GAS & ELECTRIC
COMPANY (SDG&E) ((U 902 E), AND SOUTHERN
CALIFORNIA EDISON COMPANY (SCE) (U 338 E)**

CHRISTOPHER J. WARNER
Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94105
Telephone: (415) 973-6695
Facsimile: (415) 973-0516
E-Mail: CJW5@pge.com

Attorney for
PACIFIC GAS AND ELECTRIC COMPANY

ALLEN K. TRIAL
San Diego Gas & Electric Company,
101 Ash Street
San Diego, California 92101-3017
Telephone: (619) 699-5162
Facsimile: (619) 699-5027
E-Mail: ATrial@semprautilities.com

Attorney for
SAN DIEGO GAS & ELECTRIC COMPANY

GLORIA M. ING
WALKER A. MATTHEWS, III
Southern California Edison Company
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770
Telephone: (626) 302-6879
Facsimile: (626) 302-3990
E-Mail: walker.matthews@sce.com

Attorneys for
SOUTHERN CALIFORNIA EDISON
COMPANY

Dated: July 20, 2012

TABLE OF CONTENTS

	Page
I. INTRODUCTION AND SUMMARY OF RECOMMENDATION	1
II. CES-21 IS AN INNOVATIVE AND MUCH-NEEDED COLLABORATION AMONG CALIFORNIA UTILITIES AND LLNL, A WORLD-CLASS RESEARCH INSTITUTION, TO EFFICIENTLY ADDRESS CALIFORNIA’S 21ST CENTURY ENERGY AND ENVIRONMENTAL CHALLENGES FOR THE DIRECT BENEFIT OF UTILITY CUSTOMERS	6
III. THE CRITERIA AND INITIAL “USE CASES” FOR CES-21 PROJECTS MEET AND EXCEED THE COMMISSION’S PRIORITIES AND CRITERIA FOR UTILITY RD&D PROGRAMS UNDER THE COMMISSION’S EPIC DECISION	10
A. Electric Resource Planning – Improved Electric Resource Planning Tools.....	11
B. Electric Resource Planning - Flexibility Metrics and Standards	15
C. Electric System Operations - Electric System Monitoring and Control	16
1. The CES-21 Project Will Assist The Electric Utilities In Meeting Current Challenges.....	18
2. The CES-21 Project Will Provide The Joint Utilities The Opportunity To Gain Knowledge In A Computational Approach	20
D. Gas System Operations - Natural Gas System Modeling	21
E. Cyber Security	24
IV. LLNL’S STAFF AND RESOURCES, INCLUDING HIGH-PERFORMANCE COMPUTING FACILITIES, PROVIDE A UNIQUE AND EXTRAORDINARY OPPORTUNITY FOR ENHANCING THE BENEFITS OF UTILITY RD&D	27
V. THE GOVERNANCE PROCESS FOR CES-21 WILL BE OPEN AND CONSENSUAL, PROTECT THE INTERESTS OF UTILITY CUSTOMERS, AND ENSURE THAT THE COMMISSION CAN OVERSEE THE CES-21 PROGRAM AND EXPENDITURES CONSISTENT WITH COMMISSION PRECEDENTS	32
VI. THE CES-21 FUNDING LEVEL IS REASONABLE IN LIGHT OF FUTURE NEEDS, HISTORICAL UTILITY RD&D FUNDING AND THE RD&D FUNDING “GAP” IDENTIFIED BY THE COMMISSION AND CALIFORNIA POLICYMAKERS	41
VII. THE JOINT UTILITIES’ PROPOSALS FOR COST RECOVERY AND COST ALLOCATION ARE REASONABLE AND CONSISTENT WITH COMMISSION RATEMAKING PRINCIPLES.....	43

TABLE OF CONTENTS
(continued)

	Page
A. The CES-21 Project Costs Are Allocated To The Joint Utilities Based On Pre-Determined Percentages	43
B. The Joint Utilities Request CPUC Approval For Full Recovery Of All Forecast Costs Without Subsequent Reasonableness Review, Consistent with Traditional Cost of Service Ratemaking	44
C. CES-21 Project Costs Should Be Collected Through Distribution Rates, Except For Projects That Are Generation-Related	44
D. Summary of the Joint Utilities Cost Recovery Proposals	45
1. PG&E’s CES-21 Cost Recovery Proposal	45
2. SCE’s CES-21 Cost Recovery Proposal	46
3. SDG&E’s CES-21 Cost Recovery Proposal	47
VIII. CONCLUSION – CES-21 IS REASONABLE, IN THE PUBLIC INTEREST, AND SHOULD BE APPROVED	47

TABLE OF AUTHORITIES

CALIFORNIA STATUTES

Cal. Pub. Util. Code § 381(a) and (b).....44
§ 740.1.....3, 5
§ 8360.....5

CALIFORNIA PUBLIC UTILITIES COMMISSION DECISIONS

Opinion Modifying the Proposed Settlement Agreement of Pacific Gas & Electric Company, PG&E Corporation and the Commission Staff and Approving the Modified Settlement Agreement, D.03-12-035 (Dec. 18, 2003).....40

Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge and Establishing Funding Collections for 2013-202, D.12-05-037 (May 24, 2012)..... passim

ADMINISTRATIVE LAW JUDGE RULING

Administrative Law Judge’s Ruling (Jan. 17, 2012) A.11-07-008.....35

MISCELLANEOUS

Senate Bill (“SB”) 2 1X (Stats 2011-2012 1st Ex Session Ch 1)..... 18
Assembly Bill 1890, (Stats 1996 Ch 854) 44, 45

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

Application of Pacific Gas and Electric Company (U 39 M), San Diego Gas & Electric Company (U 902 E), and Southern California Edison Company (U 338 E) for Authority to Increase Electric Rates and Charges to Recover Costs of Research and Development Agreement with Lawrence Livermore National Laboratory for 21st Century Energy Systems

A.11-07-008
(Filed July 18, 2011)

**OPENING BRIEF OF PACIFIC GAS AND ELECTRIC
COMPANY (PG&E) (U 39 M), SAN DIEGO GAS & ELECTRIC
COMPANY (SDG&E) (U 902 E), AND SOUTHERN
CALIFORNIA EDISON COMPANY (SCE) (U 338 E)**

Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E) (collectively, "Joint Utilities") provide their opening brief in support of the California Energy Systems for the 21st Century Project (CES-21). For the reasons discussed below, the Commission should approve CES-21 as reasonable, in the public interest, and likely to provide unique and extraordinary benefits to customers in meeting California's 21st century energy and environmental policy goals and challenges.

I. INTRODUCTION AND SUMMARY OF RECOMMENDATION

CES-21 is one of the most extraordinary, innovative and positive collaborations on energy and environmental research, development and demonstration (RD&D) in the history of California. In one place, CES-21 will bring together an unprecedented collaboration of scientists and researchers from the world-renowned Lawrence Livermore National Laboratory (LLNL); technical and operating experts from all three California investor-owned electric and gas utilities; the policy and regulatory expertise of the California Public Utilities Commission; the public interest energy policy and research expertise of the California Energy Commission; and the electric system and grid experience and technical know-how of the California Independent

System Operator.^{1/} The CES-21 collaboration will focus on one goal, and one goal only:

Successfully addressing and surmounting the energy and environmental challenges facing California in the 21st century.

The CES-21 collaboration also will be unprecedented in another way – it will be an open and non-exclusive collaboration, with a transparent governance process that will leverage expertise and participation from all across California to address California’s energy and environmental challenges. The governance process will ensure that the projects funded by CES-21 do not duplicate other projects and research undertaken by others; that the results of the projects are shared and disseminated widely for the benefit of customers; and that the Commission maintains complete and continuous oversight of the collaboration.

The \$30 million per year costs of CES-21 are reasonable, particularly in light of the Commission’s own findings that energy RD&D funding has fallen steadily since 1978, and that the current funding “gap” for California energy RD&D spending could be as much \$670 million per year.^{2/} The \$30 million in annual costs are spread across the service areas of all three of the Joint Utilities, further reducing the costs to customers.^{3/} In addition, the potential savings from CES-21 could far exceed the annual cost of the program. Savings estimates range from up to \$30 million per year to \$552 million by 2020.^{4/}

CES-21 fully meets and exceeds the Commission’s criteria for utility-funded RD&D funding, including the criteria recently adopted by the Commission in its Electric Program Investment Charge (EPIC) proceeding.^{5/} Consistent with the EPIC decision and the criteria for

^{1/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, pp. 1-5, 1-9, 1-10 and Attachments A and B.

^{2/} *Electric Program Investment Charge, Staff Proposal*, February 10, 2012, R.11-10-003, pp. 9- 10, 17; D.12-05-037, *Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge and Establishing Funding Collections for 2013- 2020*, May 24, 2012, p. 6.

^{3/} Exhibit U-1, Joint Utilities’ Direct Testimony, pp. 1-16, 3-1- 3-3.

^{4/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, pp. 3-4- 3-5.

^{5/} D.12-05-037, Ordering Paragraphs 2- 4, 12, May 24, 2012.

utility RD&D funding in Public Utilities Code Section 740.1, CES-21's investment planning and project approval process:

- Maps the planned investments to the electricity system value chain, including grid operations, generation, transmission, distribution, and demand-side management;^{6/}
- Identifies the amount of funds to be devoted to particular program areas (applied research and development, technology demonstration and deployment, and market facilitation);^{7/}
- Provides policy justification for the funding allocation proposed;^{8/}
- Takes into account and avoids duplication of the research, development, and demonstration activities the utilities are already undertaking as part of their approved energy efficiency and demand response portfolios;^{9/}
- Identifies the type of funding mechanisms (grants, loans, pay-for output, etc.) to be used for each investment area;^{10/}
- Establishes eligibility criteria for award of funds in particular areas, as well as limitations for funding (per-project, per-awardee, matching funding requirements, etc.) and other eligibility requirements (technologies, approaches, program areas, etc.);^{11/}

^{6/} Exhibit U- 1, Joint Utilities' Direct Testimony, pp. 1-1- 1-15.

^{7/} *Id.*, pp. 1-3- 1-15; Exhibit U-2, Joint Utilities' Supplemental Testimony, pp. 1- 4, referencing project selection process and development of strategic plan and annual budgets.

^{8/} *Id.*

^{9/} Exhibit U- 1, Joint Utilities' Direct Testimony, pp. 1-13- 1-15; Joint Utilities' Supplemental Testimony, pp. 1- 4.

^{10/} *Id.*

^{11/} *Id.*

- Provides for stakeholder comments during the development of CES-21 investment plans and projects, and responses to the comments;^{12/}
- Provides for performance metrics and business case goals against which the program's and each project's success should be judged, including quantification of estimated costs and benefits to ratepayers and to the state, such as potential energy and cost savings, economic benefits, environmental benefits, and other benefits;^{13/}
- Identifies barriers or issues resolved that prevented widespread deployment of technology or strategy;^{14/}
- Evaluates the effectiveness of dissemination and sharing of information and results from CES-21, including adoption of technology, strategy and research data by others;^{15/}
- Solicits and maximizes funding sharing and collaboration for CES-21 projects and strategies with others, including other California public and private energy research institutions;^{16/}
- Addresses the treatment of intellectual property associated with CES-21 projects, in order to ensure that the benefits of CES-21 projects are available to utility

^{12/} Exhibit U- 1, Joint Utilities' Direct Testimony, p. 1-3- 1-4; Joint Utilities' Supplemental Testimony, pp. 1- 5.

^{13/} Exhibit U- 2, Joint Utilities' Supplemental Testimony, pp. 2- 4, referencing project selection process and business case criteria.

^{14/} *Id.*; Exhibit U-1, Joint Utilities' Direct Testimony, Chapter 2 "Illustrative Use Cases;" Joint Utilities' Rebuttal Testimony, Chapter 3, "Illustrative Use Cases – Probability of Benefits, Reasonableness of Costs, Avoidance of Duplication, and Evaluation of Lawrence Livermore National Laboratory Services."

^{15/} Exhibit U- 1, Joint Utilities' Direct Testimony, p. 1-14, discussing dissemination and sharing of results of projects.

^{16/} Exhibit U- 1, Joint Utilities' Direct Testimony, p.1-16; Joint Utilities' Supplemental Testimony, pp. 4- 5.

customers and the public, as appropriate;^{17/}

- Complies with the statutory principles and goals articulated in Public Utilities Code Sections 740.1 and 8360.^{18/}

In support of CES-21, the Joint Utilities presented extensive testimony by witnesses with expertise in Commission and California policies and requirements for energy RD&D programs and governance of those programs; internal expertise in utility needs and gaps in energy RD&D; expertise on LLNL's staff, resources and facilities available to meet those needs; and utility ratemaking and cost recovery policies to fairly and equitably recover the costs of CES-21 in customer rates.^{19/} In addition, the Joint Utilities provided letters of support for CES-21 from the California Energy Commission and the California Independent System Operator, as well as a letter from California U.S. Senator Dianne Feinstein endorsing the use and expertise of LLNL for developing new technologies for gas pipeline leak detection and pipeline integrity assessment.^{20/} Other institutions, such as Stanford University, the University of California system, and other California public and private research institutions, would be solicited to participate and provide proposals for consideration under CES-21.^{21/} The Joint Utilities also presented testimony demonstrating that the level of funding and scope of energy RD&D to be funded by CES-21 is modest and comparable to past RD&D funding decisions approved by the

^{17/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 1-14.

^{18/} Exhibit U- 1, Joint Utilities' Direct Testimony, pp. 1-2- 1-3; Joint Utilities' Supplemental Testimony, pp. 1-4.

^{19/} Brian K. Cherry, Vice President, Regulatory Relations, PG&E; Antonio J. Alvarez, Manager, Energy Policy, Planning and Analysis Department, PG&E; Stephen J. Mikovits, Director, SDG&E Application Services; Robert Sherick, Manager, Power System Technologies and Consulting Services, SCE; Kevin Wong, Supervising Gas Engineer, Gas System Planning, PG&E; Dr. S. Julio Friedmann, Chief Energy Technologist, LLNL; David P. Bayless, Manager, Operations and Proceedings Department, PG&E; Yvonne M. Le Mieux, Principal Regulatory Economics Advisor, Strategic Analysis and Pricing Department, SDG&E; Douglas A. Snow, Manager, Revenue Requirements, SCE.

^{20/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, Chapter 1, Attachments A and B.

^{21/} Exhibit U-2, Joint Utilities' Supplemental Testimony, pp. 4- 5.

Commission.^{22/}

Based on the testimony and record evidence in this proceeding, the Joint Utilities respectfully request that the Commission approve their application for approval of CES-21 in this proceeding.

The following sections of this brief will provide additional details that demonstrate how CES-21 is reasonable and in the public interest and will efficiently address California's 21st century energy and environmental challenges for the direct benefit of utility customers and at reasonable cost.

II. CES-21 IS AN INNOVATIVE AND MUCH-NEEDED COLLABORATION AMONG CALIFORNIA UTILITIES AND LLNL, A WORLD-CLASS RESEARCH INSTITUTION, TO EFFICIENTLY ADDRESS CALIFORNIA'S 21ST CENTURY ENERGY AND ENVIRONMENTAL CHALLENGES FOR THE DIRECT BENEFIT OF UTILITY CUSTOMERS

In support of CES-21, the Joint Utilities presented testimony demonstrating that the complexity of today's energy industry challenges requires new tools and techniques, and that LLNL, a world-class research institution, has the facilities, resources and staff to provide those tools and techniques.^{23/} While traditional desktop simulations work well for a variety of analyses and applications, the high power computing capabilities of LLNL could provide a quantum leap in the IOUs' ability to analyze more data faster. According to the Joint Utilities, this capability is important for three reasons:

First, the sheer volume of data the IOUs are confronting is dramatically increasing. For example, just taking into account the IOUs Advanced Metering Infrastructure projects, the amount and quality of granular energy usage data available to be analyzed and used for utility operational improvements and customer-facing energy management programs has increased several orders of magnitude, from 20 million customers with only 12 data points of

^{22/} Exhibit U-1, Joint Utilities' Direct Testimony, Chapter 1, Attachment A.

^{23/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 1-5.

energy usage per year, to the same number of customers with 35,040 data points per customer per year.^{24/}

Second, as acknowledged by numerous studies and reports on energy and environmental issues in California, the complexity of issues confronted by California energy utilities, customers and policymakers today is also increasing.^{25/}

Third, high power computing will significantly reduce the time to run simulations and thus help the IOUs be more responsive to the demands of today's business and regulators. Access to the high power computing capabilities of LLNL will help the IOUs and policy makers analyze and understand the complex issues presented by California's 21st century energy and environmental goals, including reducing greenhouse gas emissions, improving the safety and reliability of the electric grid and gas pipeline system, reducing energy costs, and providing customers with greater choices to manage their energy usage.^{26/}

Further, the time savings will allow for more granular analysis of the data and lead to different conclusions, better policy choices and, most importantly, cost savings. LLNL's high performance computing may provide an additional tool to deal with this increasing complexity and the need for real-time data analysis. Current desk-top computer simulations are often inadequate to provide timely solutions to operational questions.^{27/}

LLNL is an excellent partner for computing know-how and is one of the preeminent centers in the world for solving complex problems with modeling and simulation, science-based decision support, and broad technology development and engineering. As Dr. S. Julio Friedmann, Chief Energy Technologist of LLNL testified, LLNL is the country's and

^{24/} *Id.*

^{25/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 1-1- 1-3, 1-5; D.12-05-037, pp. 12- 14, May 24, 2012; *Electric Program Investment Charge, Staff Proposal*, February 10, 2012, R.11-10-003, pp. 9- 17.

^{26/} Exhibit U-1, Joint Utilities' Direct Testimony, p.1-5.

^{27/} *Id.*, pp. 1-5- 1-6.

arguably the worlds’ premier center for modeling- and simulation-based science and engineering.^{28/} The Laboratory has one-of-a-kind facilities and world-class scientific talent directly applicable to the needs of the Joint IOUs. LLNL has been addressing national challenges in the energy arena for over a half century, helping protect the country and improve American competitiveness.

Moreover, LLNL through its own initiative and the urging of the federal government has recently developed partnering mechanisms that help industry take advantage of these capabilities. The Livermore Valley Open Campus (LVOC) and the High-Performance Computing Innovation Center (HPC-IC) are examples of the proactive approach that LLNL has taken to bring its leading-edge and highly valuable resources to entities such as the Joint IOUs. Not only is LLNL the ideal candidate for the CES-21, it is the only entity that can fulfill all of the needs of this partnership.^{29/}

LLNL’s capabilities are well-known and globally recognized. LLNL is a premier applied science laboratory within the United States Department of Energy (DOE). Since its founding in 1952, LLNL has consistently provided groundbreaking solutions for its customers in a broad range of national security missions. LLNL is staffed with over 6,700 employees, including nearly 3,500 scientists, engineers, and technicians. The excellence of its technical staff coupled with the Laboratory’s demonstrated capability to solve “big science and engineering” problems, allows LLNL to maintain a balanced and complimentary portfolio of work. Recently, the DOE (LLNL’s largest customer and landlord agency) has endorsed increasing access by American industry to its investments at the national laboratories to ensure U.S. energy security and economic competitiveness.^{30/}

^{28/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, p. 2-1.

^{29/} *Id.*

^{30/} *Id.*, pp. 2-1 – 2-2.

Attributes that make LLNL a partner of choice for CES-21 include:

- A committed, vital, and talented staff.
- Unique, large, and complex research facilities.
- The world's fastest super-computer.
- The ability to solve important and difficult real-world problems.
- Cutting-edge capabilities in multiple areas of science and technology.
- Science and technology that create spin-off applications.^{31/}

Over the many decades of its existence, LLNL has maintained a highly trained, diverse technical staff to execute its many missions, including energy security. Today, the Laboratory's full-time technical staff numbers more than 2700 scientists and engineers, roughly half of whom hold doctoral degrees, many in the fields most needed for CES-21 (e.g., electrical, chemical, mechanical and power engineering, systems analysis, applied mathematics, computer science, earth and atmospheric science, economics, physics). Researchers typically work in multidisciplinary project teams, exploiting the synergy that arises from multiple perspectives and fields of expertise to solve problems that might otherwise be intractable. Nowhere else in California—indeed in very few places in the world—is there such an assemblage of high-caliber scientific talent.^{32/}

LLNL's staff also has broad experience in teaching, technical training, and professional development. Many scientists and engineers hold concurrent faculty appointments at colleges and universities both local and nationwide. The Laboratory hosts visiting faculty and students year round and sponsors hundreds of students through a variety of summer programs. LLNL also offers professional training on such topics as emergency preparedness, threat assessment,

^{31/} *Id.*, p. 2-2; <http://www.top500.org/lists/2012/06/press-release>.

^{32/} *Id.*

cyber security, and detection technologies. These efforts help to ensure that the technologies and capabilities developed at LLNL are integrated into the nation’s future workforce.^{33/}

CES-21 will leverage LLNL’s facilities (funded primarily by the DOE) and LLNL’s eminent scientific staff, to provide essential tools and capabilities for the benefit of the Joint Utilities and their customers. Together, LLNL and the CES-21 partnership are intended to provide the Joint Utilities and policymakers the best and widest range of tools and computational resources available to meet the needs of the future. This should translate into better operational performance, emergency preparedness, and cyber and physical system security. Better decision making and resource allocation would result in lower cost and higher resource utilization.^{34/}

III. THE CRITERIA AND INITIAL “USE CASES” FOR CES-21 PROJECTS MEET AND EXCEED THE COMMISSION’S PRIORITIES AND CRITERIA FOR UTILITY RD&D PROGRAMS UNDER THE COMMISSION’S EPIC DECISION

The Joint Utilities and LLNL in their testimony identified potential initial projects for CES-21 that are not exclusive, but which were chosen because each is in a category or cluster of strategic “problems” and “opportunities” which the Joint Utilities and most energy policymakers believe should be a priority for further research, development and demonstration.^{35/} As other high priority strategic problems and opportunities are identified, those too will be considered for CES-21 funding. However, the Project will not fund “undefined research.” In addition, as described in more detail in Section V, below, the governance process will ensure that the funded research is defined, including evaluation of costs and benefits, consistent with other utility customer-funded RD&D programs.

^{33/} *Id.*, pp. 2-2- 2-3.

^{34/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 1-6.

^{35/} Exhibit U- 1, Joint Utilities’ Direct Testimony, pp. 1-3- 1-11; Chapter 2; Joint Utilities’ Rebuttal Testimony, Chapter 3.

The Joint Utilities presented detailed and extensive testimony^{36/} demonstrating the potential benefits of the initial CES-21 projects and research priorities in the areas of electric resource planning, electric systems operations, gas systems operations and cyber-security, summarized as follows:

A. Electric Resource Planning – Improved Electric Resource Planning Tools

The Joint Utilities presented testimony demonstrating that utilities currently use commercial off-the-shelf or in-house developed modeling tools (e.g., Plexos) for planning electric systems.^{37/} For many pressing planning and policy questions, these models already are computationally intensive yet limited in their ability to represent the complexity of the electric grid, the time-scale of key generation and transmission, or the responsiveness of electrical storage. It is very time-consuming to run multiple scenarios of some of these existing planning models. Additionally, existing modeling methods do not fully capture the dynamic, real-time operational characteristics of California’s electric system.^{38/}

These computational bottlenecks require improvements to optimization algorithms and the appropriate application of high performance computing. New (or augmented) computational tools need to be created to meet California’s system planning needs. The tools need to balance reliability, costs, and regulatory limitations (e.g., GHG emissions), as well as transmission capabilities, economic use of supply, demand-side resources, distributed generation, and storage under uncertain system and market conditions. Given the breadth of system and energy resource costs that depend on these system planning tools, even a very small improvement in forecasting and planning has the potential to save hundreds of millions of dollars annually.^{39/}

^{36/} *Id.*

^{37/} Exhibit U-1, Joint Utilities’ Direct Testimony, pp. 1-7, 2-3- 2-5.

^{38/} *Id.*

^{39/} *Id.*, p. 1-7- 1-8; 2-5- 2-6.

One of the initial priorities of CES-21 will be to consider a project to augment existing tools and develop new analytical tools for planning necessary to meet California's energy and environmental goals and policies. Through CES-21, stakeholders will have a forum to collaborate on the development of such new tools. The CES-21 will seek to augment the functionality of existing models to better represent the complexity and responsiveness of the grid, as well as the range and volume of possible scenarios. The project should enhance the incorporation of advanced tools into the ongoing planning process of the Joint Utilities and the California Independent System Operator (CAISO), resulting in significant savings in energy, capacity and grid costs.^{40/}

The Joint Utilities presented testimony demonstrating several possible ways in which CES-21 could help resource and transmission grid planning issues for the benefit of the Joint Utilities and the CAISO:^{41/}

- CES-21 would facilitate more accurate estimates of load following requirements, and resource need. Load following capacity is needed to cover within-hour variability and hour-ahead forecast uncertainty of load and intermittent generation. CAISO has estimated load following requirements using statistical analysis based on a single weather year (2005) load and wind and solar generation profiles. The additional computing capability offered by LLNL will allow simulations to estimate the variability and uncertainty that operators see, as day-ahead forecasts or schedules are made, before the start of the operating day, and as weather and other uncertainties unfold during the day for different weather days or weather years. This type of dynamic simulation would result in more accurate estimates of the operationally flexible capacity needed to integrate renewables. If it turns out that the requirements are higher than predicted by today's statistical analysis, then California avoids the potential for customer service interruptions

^{40/} *Id.*, p. 1-8, 2-5- 2-7

^{41/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, pp. 3-1- 3-6.

created by insufficient flexible capacity being available. If it turns out that the requirements are lower than predicted by today's statistical analysis, then the state would save costs by not procuring unnecessary capacity. In either case, more accurate estimates will benefit customers.^{42/}

- CES-21 would help improve the modeling of transactions with other states or balancing authorities to better understand potential over-generation conditions created by higher levels of renewable generation, and alternatives to manage those conditions. Results provided by the current methodology show no over-generation or negative price conditions in all 33 percent renewable scenarios run. The absence of over-generation conditions is not realistic given that today, CAISO experiences negative prices in the spring with current renewable levels. This is because current modeling disposes of all surplus generation in the state via exports. With improved modeling of out-of-state operating constraints, it is possible to better estimate potential exports and over-generation conditions. However, this has been difficult because of the size of the production simulation models, and the additional constraints that need to be modeled increase the run time of the scenarios being studied. A proper representation of over-generation conditions is essential to identify reliability issues, and the need for generation curtailment or other alternatives such as storage to manage over-generation conditions.^{43/}
- CES-21 would assist in evaluating the effectiveness of different alternatives to reduce flexible capacity deficiencies identified by CAISO's renewable integration study. CAISO has previously proposed this type of analysis (Phase 2 analysis) to determine the amount and operational characteristics of resources, whether supply or demand side resources that could address the operational needs of renewable integration, in addition to the conventional combined cycle gas turbine (CCGT) and combustion turbine (CT) resource

^{42/} *Id.*, p. 3-2.

^{43/} *Id.*, pp. 3-2- 3-3.

used as proxy additions in prior integration studies. LLNL's involvement would provide computing capability to perform the multiple simulations needed to evaluate the effectiveness of different alternatives with different operating characteristics and in different amounts. Understanding the amount and operating features of alternatives needed for integration is essential to make the right procurement decisions and to provide reliable and cost-effective service to customers.^{44/}

Based on these potential modeling projects, the Joint Utilities provided estimates quantifying the potential illustrative benefits that CES-21 could provide in the areas described by the prior examples.^{45/}

- Example 1: CES-21 could improve estimates of load following requirements. Assume the CES-21 analysis shows that CAISO's current 3,500 megawatt (MW)² estimate of load following requirements for 2020 can be reduced by 10 percent. Load following requirement reduction: 10 percent of 3,500 MW or 350 MW in up and down directions. Assume load following capacity has a 60 percent utilization. Assume the market price for load following is \$8/megawatt-hour (MWh). **Benefit: 2 directions (up and down flexibility) x 350 MW x 8,760 hours x 60% x \$8/MWh = \$30 million/year.**^{46/}
- Example 2: CES-21 could improve estimate of resource need for renewable integration. Assume the CES-21 analysis shows that past CAISO 4,600 MW³ estimate of resource need for 2020 can be reduced by 10 percent. Assume new gas fired capacity cost: \$1,200 to 1,500/kilowatt (kW). **Benefit: 460 MW x \$1,200/kW = \$552 million.**^{47/}

^{44/} *Id.*, pp. 3-3- 3-4.

^{45/} *Id.*, pp. 3-4- 3-5.

^{46/} *Id.*, p. 3-4.

^{47/} *Id.*, p.3-5.

As the CAISO explained in its letter supporting and agreeing to participate as a partner in CES-21, “the California Independent System Operator (CAISO) supports efforts leading to research and development that would ready the electric transmission system for California’s energy and environmental goals. . . . If this application is approved the ISO looks forward to working with the Commission, IOUs and the LLNL in the research and develop efforts that would ready the electric transmission system for achieving the state’s energy policy goals.”^{48/}

B. Electric Resource Planning - Flexibility Metrics and Standards

The Joint Utilities testified that new flexibility metrics for electric resource planning also are needed to operate the state’s future electricity grid in a secure and flexible way to ensure that California’s energy and environmental goals are operationally feasible, and to help design energy and ancillary service markets. Given the planned increase in intermittent renewables, the grid needs to be more responsive and flexible than it is today.^{49/}

However, current planning and operating guidelines do not consider the grid’s operating flexibility needs, especially in the context of increased intermittency. One of the first priorities of CES-21 will be to consider a research project to develop flexibility metrics and standards to guide the planning and operation of California’s electric grid in a future where a large portion of the state’s electric supply is provided by resources that offer little or no operating flexibility. Specifically, this CES-21 project will seek to build on efforts by the North American Electric Reliability Council (NERC), the Western Electricity Coordinating Council (WECC), the Lawrence Berkeley National Laboratory, CAISO, and other stakeholders to consider the needs of the entire California and Western electric grid in the face of changing policy, climate, and technology.^{50/}

^{48/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, Attachment B, pp. 1B-1- 1B-2.

^{49/} Exhibit U-1, Joint Utilities’ Direct Testimony, pp. 1-8, 2-7- 2-10.

^{50/} *Id.*, pp. 1-8- 1-9, 2-10- 2-12.

In addition to developing these new flexibility metrics, CES-21 may also utilize standard reliability, efficiency, and environmental impact metrics when using simulation, optimization, and other analysis models to evaluate the performance of the electric system under different scenarios. The new tools developed may help determine which flexibility metrics can best measure system needs and requirements, and how these metrics can be used or adjusted for planning purposes. The results from these research project activities could help inform decision makers about what investments or initiatives are needed to reliably operate the State's electric system under California's Clean Energy Plan, which may include new flexible generation, new market products, and regulatory policy changes.^{51/}

C. Electric System Operations - Electric System Monitoring and Control

The Joint Utilities presented testimony demonstrating that one of the key operational issues faced by California utilities is the ability to manage intermittent resources effectively while utilizing grid assets efficiently.^{52/} This has historically been done through centralized collection of field data monitored by various operational entities (e.g., regional coordinators, balancing authorities, and transmission providers) with support from operational engineering personnel. It has also been accomplished using generation resources with fairly predictable and controllable output. Even with today's very mature generation mix, instability and system wide outages occur on a periodic basis. With the increasing amounts of intermittent resources, stability analysis becomes more critical than ever to understand the possible impacts on reliability and to develop mitigation plans.^{53/}

^{51/} *Id.*, p. 1-9.

^{52/} *Id.*, pp. 1-9- 1-10, 2-13- 2-14.

^{53/} *Id.*

In addition, system operators, including the Joint Utilities, study and monitor the health of the system for: (1) future events such as line maintenance and generator outages; (2) real-time monitoring; and (3) post-analysis to discover root causes of significant system events. This leads to a tremendous amount of system data that is created, processed, and analyzed. While there are useful tools and computing analysis software that exist today, much of the data is recorded but not collected in any single system that could analyze the data holistically for trends or indicators of system stress.^{54/}

One of the initial priorities of CES-21 will be to consider a research project to develop methods to increase the analytical capabilities of the IOUs to monitor and control the bulk power system, including managing intermittent resources effectively.^{55/} The potential benefits from this project would include:

- Improved monitoring capability and system dynamics understanding to reduce overall system outages through early warning and mitigation plans
- Reduced generation and load dropping on special protection schemes
- Increased wide area system awareness and understanding to increase transmission capacity
- More detailed modeling capabilities and longer dynamic analysis to increase overall understanding of interplay between transmission and distribution systems with both having substantial amounts of intermittent generation.^{56/}

The Joint Utilities described further details and benefits of the Electric System Monitoring and Control “use case” and potential project as follows:

^{54/} *Id.*, pp. 1-10, 2-13- 2-14.

^{55/} *Id.*, pp. 1-10, 2-14- 2-18.

^{56/} *Id.*

1. The CES-21 Project Will Assist The Electric Utilities In Meeting Current Challenges

The Electric System Monitoring and Control Use Case Scenario is one of the four use case scenarios the Joint Utilities have presented that describe representative CES-21 projects. As indicated in the Joint Utilities' testimony, use case scenarios are illustrative in nature, in that they are subject to further development, review, and approval by the CES-21 Board of Directors as part of the CES-21 Project's overall strategic plan.^{57/} Other similar types of projects could also be developed, reviewed, and approved by the CES-21 Board of Directors that are not identified in the representative use case scenarios.

The Joint Utilities believe that CES-21 Project research regarding Electric System Monitoring and Control address critical energy issues they face in California today. These include:^{58/}

- **Effectively meeting the required Renewable Portfolio Standard (RPS).**

The electric utilities are under SB 2(1x), which would require them to obtain a third of their electricity from renewable resources, including approximately 20,000 additional MW of intermittent wind and solar resources.^{59/} The CES-21 project will help the electric utilities meet this aggressive goal, which is unique to California.^{60/} Specifically, the research from the CES-21 project will be able to provide advanced data analysis and control schemes to mitigate the impact of intermittency, while ultimately optimizing the use of power system resources.^{61/}

^{57/} *Id.*, pp. 2-2 to 2-3.

^{58/} *Id.*, p. 2-1; Exhibit U-3, Joint Utilities Rebuttal Testimony, p. 3-7.

^{59/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 2-1.

^{60/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 3-9.

^{61/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 3-10; see also, Tr., Vol. 2, pp. 217-218 (SCE, Sherick) (May 11, 2012).

- **Managing impacts from Once Through Cooling restrictions.**

The research performed through the CES-21 Project will provide the electric utilities with additional analytical tools to meet the goals of California’s Clean Energy Plan, whereby California seeks to retire, replace, and/or mitigate once-through cooling power plants, which could affect over 16,000 of thermal resources by 2020.^{62/}

- **Enabling increased adoption of distributed resources.**

Likewise, the CES-21 Project will assist the electric utilities in their efforts to meet the state’s goal of promoting distributed generation technologies, including the California Solar Initiative and Small Generator Incentive Program, targeting an additional 5,000 MW of solar photovoltaic supplies and combined heat and power plants.^{63/}

- **Maintaining System Reliability and stability with increasing intermittent resources.**

As indicated by SCE witness Sherick, with the increasing amount of intermittent resources, there is a tremendous amount of system data that is created, processed and analyzed, and stability analysis becomes more critical.^{64/} The CES-21 project could fill the current void that exists today due to the lack of a single system that can analyze the data holistically for trends or indicators of system stresses.^{65/}

Further, as indicated by Mr. Sherick, there are at least four benefits associated from this use case scenario. Ratepayers will benefit from.^{66/}

^{62/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 2-1.

^{63/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 2-1.

^{64/} Exhibit U-1, Joint Utilities’ Direct Testimony, pp. 2-13 to 2-14.

^{65/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 2-14.

^{66/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 2-14.

- Improved monitoring capability and system dynamics understanding to reduce overall system outages through early warning and mitigation plans.
- Reduced generation and load dropping on special protection schemes.
- Increased wide area system awareness and understanding to increase transmission capacity.
- More detailed modeling capabilities and longer dynamic analysis to increase overall understanding of interplay between transmission and distribution systems with substantial amounts of intermittent generation.

2. The CES-21 Project Will Provide The Joint Utilities The Opportunity To Gain Knowledge In A Computational Approach

As testified by SCE witness Sherick, the CES-21 project will provide the Joint Utilities the ability to work with the Lawrence Livermore Lab in a collaborative fashion and gain knowledge in a computational approach that the Joint Utilities currently do not possess.^{67/} Moreover, the research performed through the CES-21 project can be tailored specifically to the needs of California, that other non-regional entities are unwilling to perform.^{68/} As stated by witness Sherick:

“Research is an outgrowth of solving customer problems within a particular service area. The issues that the California Joint Utilities are solving are often of a nature that many other utilities in the industry are only beginning to evaluate or are not on their agenda at all. Creating a collaborative research effort like CES-21 is an opportunity to focus on California drivers and their resulting unique issues.”

Further, the Joint Utilities believe that they will be able to leverage existing operational and research projects. For example, SCE and PG&E are currently conducting ongoing research work on adaptive protection in collaboration with the California Institute for Energy and the

^{67/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, p. 3-7.

^{68/} Tr., Vol. 2, p. 219 (SCE, Sherick) (May 11, 2012).

Environment, Virginia Tech, and Mississippi State University.^{69/} These efforts are aligned with the objectives of the Electric System Monitoring and Control use case, but the use case extends this work with the broader policy objective of creating a control unit that would more efficiently use system resources.^{70/}

For this project, like the other initial priority projects, the collaboration among LLNL, the Joint Utilities, and the CAISO should result in a more efficient and effective research program than if the projects were pursued separately.

D. Gas System Operations - Natural Gas System Modeling

PG&E witness Wong presented testimony that PG&E currently models its gas backbone, transmissions and distribution systems with software platforms such as the SynerGEE hydraulics code developed by G. L. Noble Corporation.^{71/} This software application calculates pressure drops on a pipeline system while taking into account the various compressors, regulators, and other equipment on the system. For a given demand scenario and configuration of regulator and compressor set points, the application calculates the resulting pressures and flows throughout the system.^{72/}

These models are computationally intensive and require a significant amount of time and resources to run. The immediate business need is therefore to be able to run numerous hydraulic scenarios (perhaps hundreds or even thousands) without the need for user intervention.^{73/}

^{69/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 3-9.

^{70/} *Id.*

^{71/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 1-10; 2-18- 2-19.

^{72/} *Id.*, pp. 1-10- 1-11; 2-18- 2-19.

^{73/} *Id.*, p. 1-11; 2-18- 2-19.

In addition, these models have known limitations which affect their flexibility and the speed with which they can be manipulated, even by the most skilled and experience gas planning engineers. By improving the natural gas modeling platforms and the existing hydraulics code, utilities could gain improvements in modeling speed, resolution, and fidelity.^{74/}

More specifically, PG&E's witness testified that batch run capability and optimization are very important for natural gas system modeling. LLNL's high-performance computing resources and techniques could allow PG&E to analyze its gas system under a wide range of conditions and can provide a much greater understanding of how changes to the system will impact the operation of the system and/or service to customers. LLNL's support would provide benefits, because batch run capability is currently not a feature that is built into the GL Noble software used by PG&E. PG&E currently has to build code around the GL Noble software to gain the batch run capability that it needs. This additional code needs to be maintained and updated as the main application changes. The GL Noble software does have an optimization module. However, in scenarios where the base system is significantly altered, the optimization routine needs some user intervention to converge to a solution.^{75/}

Having a robust and stable optimization engine is very important for those instances where PG&E's analysis time is limited and it needs to do numerous runs in a very short amount of time. LLNL's extensive experience and expertise in optimization can be leveraged to enhance the optimization algorithms in GL Noble's software to improve its stability.^{76/}

LLNL also has High Performance Computers (HPC) that can aid PG&E in running these simulations faster. When PG&E has numerous batch runs to complete, LLNL's HPC

^{74/} *Id.*

^{75/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 2-20- 2-21; Exhibit U-3, Joint Utilities' Rebuttal Testimony, pp. 3-14.

^{76/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, pp. 3-14.

could be used to gain results in a fraction of the time it normally would take on a desktop computer or laptop. LLNL's computing technology can also be used to analyze PG&E's gas system under a wide range of conditions to determine which variables are important in a simulation. With this knowledge, PG&E can configure its models to run more efficiently and quickly, even when running on a conventional laptop.^{77/}

Improved batch run and optimization technology should result in higher resolution simulation results. Higher resolution results mean that it will be more likely that the true optimum system configuration will be found. PG&E's witness testified that, for investment planning purposes, being able to identify the optimum result will minimize the investments needed on the system. PG&E's capital expenditures for gas transmission as established in Gas Accord V are approximately \$175 million per year. *PG&'s witness also testified that if these expenditures could be reduced by just 1 percent as a result of enhanced modeling capabilities, the savings would amount to \$1.75 million per year, or \$8.75 million over five years.*^{78/}

Online, real-time simulation is also a technology that PG&E is interested in moving towards using CES-21.^{79/} The real-time technology can provide benefits in areas such as leak detection, realistic training simulations, and "what if" modeling. The "what if" modeling can be a very powerful tool on days where the system is operating on the edge of its performance envelope. Since a real-time simulator is always up to date and being fed real-time pressures and flows, a planning engineer can quickly run several scenarios starting from the current system state to determine the best way to operate for the rest of the day. Online simulators do require a lot of data from the field in order to be effective though. LLNL has expertise and technologies to analyze the gas system and models to determine which locations would benefit the most from

^{77/} *Id.*, pp. 3-14-3-15.

^{78/} *Id.*, p. 3-15.

^{79/} *Id.*

additional instrumentation. This type of analysis will help prioritize the installation of the field devices needed to support the simulator.^{80/}

PG&E witness Wong testified that PG&E is embracing new technology and looking for opportunities to incorporate them into the gas planning process. Having LLNL and CES-21 available to support PG&E and its vendors in areas in which LLNL has expertise would be very beneficial and could produce significant customer savings.^{81/}

E. Cyber Security

The Joint Utilities testified that the world today hosts a variety of cyber security threat actors that are more sophisticated, well-funded, and persistent than ever before.^{82/} It is well known that IOUs and the critical infrastructure they support are significant targets. The grid's growing interconnection and complexity is introducing new cyber vulnerabilities that need to be managed. For example, just the addition of advanced metering infrastructure for 20 million customers within the service territories of the Joint Utilities, while providing a whole new scale of potential customer benefits and cost efficiencies, also expands geometrically the potential points of contact that could be exploited by cyber-attacks and cyber-terrorists. Likewise, a cyber-attack that takes down any of the Joint Utilities' major transmission lines has the potential to cause hundreds of millions of dollars in damage to consumers, businesses and the economy.^{83/}

The Joint Utilities testified that one of the initial priority projects that CES-21 will consider is using LLNL cyber-security experts and facilities to enable the IOUs to meet these cyber-security challenges, including building a more resilient, reliable grid and protecting customer privacy.^{84/} This priority project should help the Joint Utilities, regulators and other

^{80/} *Id.*

^{81/} *Id.*

^{82/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 1-6- 1-7, 2-21- 2-22.

^{83/} *Id.*

^{84/} *Id.*

stakeholders to anticipate cyber security risks, drive research, influence standards, and develop the next generation tools and methodologies needed to continue to protect the grid from evolving and increasingly complex threats.

The Joint Utilities presented testimony demonstrating that the potential cyber-security benefits of CES-21 fall into three categories: (1) information sharing, (2) thought leadership via an active Public/Private partnership and (3) commercialization of cyber security operational capabilities.^{85/}

First, the proposed structure of the CES-21 Program establishes the context for a series of formal collaboration opportunities between entities with varying levels of access to cyber security threat and vulnerability information and resources. Access to – and sharing of – this information is critical to addressing potential large scale cyber security risks associated with managing the grid in California. The governance aspects of the CES-21 Program described in section V of the brief below, requiring approved projects to be within a well-defined scope, provide a forum to foster this collaborative approach. This will provide significant benefits to the Joint Utilities whose daily responsibility to operate and manage the grid is continuously focused on balancing operational risk while maximizing operational efficiency for the benefit of their customers.^{86/} California utility customers will benefit because the CES-21 Program will be able to leverage existing partnerships that LLNL has with the top cyber security thought leaders and experts within both the government and the national laboratory system.^{87/}

Second, by establishing CES-21’s public/private partnership, California will benefit from the type of thought leadership that has resulted in LLNL solving very complex and sensitive cyber-security and other problems at scale that would not be feasible otherwise (e.g., large-scale simulation to replace nuclear weapons testing). More specifically, by leveraging the extensive

^{85/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, pp. 3-11- 12.

^{86/} *Id.*, p. 3-11.

^{87/} *Id.*

collaborative ties that LLNL has already developed and established with academic partners, government organizations, and Department of Energy/Department of Defense laboratories, CES will provide the Joint Utilities with a formal mechanism to broker and integrate the best ideas and capabilities from a broader network of cyber security professionals.^{88/}

The third broad category of anticipated benefits is the potential commercialization of cyber security operational capabilities. This could be achieved via the development of tools/techniques that can then be applied by all three Joint Utilities to their specific system implementations and operational practices, or in some cases via direct utility investment to build upon the basic concepts and foundational results of CES-21 cyber security R&D projects. This also provides a platform that can then enable each of the Joint Utilities to share a common set of feedback which creates accelerated efficiencies as the commercial capabilities develop over time.^{89/}

In short, in the area of cyber-security, CES-21 will focus on using LLNL cyber-security facilities, expertise and “know-how” to enable the Joint Utilities to enhance their cyber security posture as new applications and technologies evolve and the grid becomes smarter, more interconnected, and more complex.

The Joint Utilities’ testimony and the record in this proceeding demonstrate in detail that CES-21 provides the Joint Utilities and their customers a unique, innovative and much-needed opportunity to collaborate with LLNL, a world-class research institution, to efficiently address the priority electric resource planning, electric and gas system operations, and cyber-security challenges that are critical to the success of California’s 21st century energy and environmental goals.

^{88/} *Id.*, p. 3-11- 3-12.

^{89/} *Id.*, p. 3-12.

IV. LLNL'S STAFF AND RESOURCES, INCLUDING HIGH-PERFORMANCE COMPUTING FACILITIES, PROVIDE A UNIQUE AND EXTRAORDINARY OPPORTUNITY FOR ENHANCING THE BENEFITS OF UTILITY RD&D

Dr. Friedmann of LLNL provided detailed testimony describing the capabilities, facilities and staffing available at LLNL to support CAES-21.^{90/} In addition to the staffing discussed in Section II, above, Dr. Friedmann and the other witnesses described LLNL's unique facilities.^{91/}

High-Performance Computing: One of the elements of LLNL's potential services under CES-21 that is particularly unique and not easily replicated by others is its High Performance Computing (HPC) facility. This facility is unparalleled and houses some of the fastest computers in the world. Access to HPC and LLNL's computing and modeling experts is central to many of the projects that the Joint Utilities intend to consider under CES-21. LLNL's HPC facilities and the Livermore Valley Open Campus are part of a broader initiative by LLNL and the U.S. government to leverage government-owned or operated high-performance computing facilities to improve the competitiveness of U.S. industries.^{92/}

Dr. Friedmann testified, that, for decades, the U.S., mainly through the work of the DOE, has applied high-performance computing to address some of the most challenging problems facing the nation. Time and again, this computing capability has propelled the U.S. to the forefront of its competition by solving previously untenable problems at less cost and in less time. For example, the DOE is faced with the need to replace aging infrastructure due to material degradation of strategic national security structures; in one instance, HPC-based modeling and simulation performed by LLNL indicated that a planned expenditure of over \$6 billion was not necessary, resulting in a significant cost avoidance that directly benefited American taxpayers. Recently, this same computing capability was applied in a partnership with Navistar, a global conglomerate and a leading manufacturer of heavy trucks for transportation

^{90/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, Chapter 2.

^{91/} *Id.*, pp. 2-3- 2-6.

^{92/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 1-8.

and shipping. Working with Navistar, LLNL used HPC-based modeling to develop innovative, low-cost aerodynamic improvements to semi-truck and trailer designs. These improvements are now being deployed across the U.S. trucking industry and will result in a savings of up to \$24 billion in fuel costs alone.^{93/}

Despite these and other successes, HPC-based modeling and simulation have remained relatively inaccessible to industry due to the high demand by government programs and the inability of industry to build and maintain the expertise needed to utilize high-performance computing. LLNL is changing this. Located adjacent at LVOC, the HPC-IC includes networked conference rooms, classrooms, collaboration areas, and office space for partner personnel as well as access to world-class supercomputers. The computing assets and expertise in the HPC-IC benefit from several billion dollars of investment by the U.S. government. To help partners get the most value from HPC technologies, the HPC-IC provides three essential elements that, in the past, have proven to be barriers to HPC application—namely, world-class talent, cost-effective access to supercomputing, and the required software. The HPC-IC resources come at a very competitive price. If the Joint Utilities were to build this facility on their own, the cost would be in excess of half a billion dollars; through the CES-21 partnership, these resources will be available at about one-tenth that amount. Considering that California’s Smart Grid is now producing the equivalent of a Library of Congress of data each day, HPC capabilities are not only cost effective, they are essential for an energy RD&D program of the scope and breadth of CES-21.^{94/}

Dr. Friedmann also testified that, to carry out its national security missions, LLNL has designed, built, staffed, and operated additional unique, world-class facilities. CES-21 will leverage these facilities (funded primarily by the DOE), providing essential tools and capabilities for the Joint Utilities. Several of these other LLNL facilities have particular relevance for CES-

^{93/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, p. 2-5.

^{94/} *Id.*, pp. 2-5- 2-6.

21.^{95/}

Terascale Simulation Facility (TSF): This several-hundred-million-dollar facility ranks unquestionably as the nation's premier supercomputer facility and houses several of the world's fastest computers. These machines are used to tackle applied science and engineering problems for LLNL's national security missions and have been the training ground for some of the best supercomputing scientists in the world. The facility operates 24/7 and is staffed by roughly 200 experts in advanced computing systems. The TSF and LLNL's other computing facilities support scientific discoveries and solve real-life problems that protect lives, promote industry competitiveness, and reduce the cost of products and services. The TSF's staff, hardware, infrastructure, and multiple computing architectures provide an opportunity for early work on CES-21.^{96/} The TSF hosts the world's fastest and largest computer and also a unique, high-performance computing platform dedicated in part to industry partnerships.^{97/}

High-Explosives Application Facility (HEAF): This one-of-a-kind building is specially designed for handling explosives and high-energy materials in a safe and controlled environment. With HEAF, researchers can test energetic and high-strain rate materials—for example, measuring and characterizing the response of cast iron or cold rolled steel to extreme pressures and temperatures. Coupled with LLNL's advanced supercomputing models and simulation capabilities, HEAF has been used to evaluate pipeline systems and critical infrastructure, saving money and lives.^{98/}

National Atmospheric Release Advisory Center (NARAC): Funded by 31 U.S. government agencies at approximately \$15 million annually, NARAC is a 24/7 emergency response center for monitoring and predicting hazardous atmospheric releases worldwide. The

^{95/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, pp. 2-3- 2-4.

^{96/} *Id.*, p. 2-3.

^{97/} [Http://www.top500.org/lists/2012/06/press-release](http://www.top500.org/lists/2012/06/press-release).

^{98/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 2-3.

facility constantly gathers weather and meteorological data, calculates real-time atmospheric conditions, and creates weather archives in order to respond to releases of chemical, biological, radiological, or natural hazardous materials. NARAC coordinates with 23 government agencies and thousands of partners worldwide for real-time emergency response. NARAC requires extensive computational capabilities to generate its high-resolution plume predictions (which incorporate wind speed, humidity, particle transport, solar intensity, and other key meteorological parameters) and for data storage and mining. In addition to its emergency response mission, NARAC's capabilities are also being used to improve wind prediction models for wind-power generation facilities and can also be applied to help IOUs obtain more power from new and existing renewable energy generation and reduce costs to ratepayers.^{99/}

Dr. Friedmann also testified that, in addition to these world-class facilities, LLNL staff has provided technical and research support on key energy issues of direct relevance to California's energy and environmental goals. The following are some examples:

Resource Modeling: Today's electric grid is becoming extremely complex and challenging to operate. To ensure sufficient energy supplies, backup resources are procured by utilities and grid operators at the ratepayers' expense. The tools that planners and operators have been using to model the grid need to incorporate this increasing complexity in order to find ways to reduce the cost of these energy resources. However, the computational power and expertise needed to run the models has not been available—until now. LLNL is using its HPC resources to add the required complexity to these models and, in so doing, make it possible to better plan and utilize the billions of dollars in assets owned by the utilities. LLNL has partnered with several entities, including Energy Exemplar, ISO New England, and General Electric (GE), to add computational power to their models.^{100/}

^{99/} *Id.*, pp. 2-3- 2-4.

^{100/} *Id.*, pp. 2-6- 2-7.

Infrastructure Vulnerability Assessment: At the request of two large municipal customers (names protected), LLNL recently undertook complex physical vulnerability assessments of infrastructure in major metropolitan areas. The assessments included ports, living and transportation systems, major industry, and a combination of new and old infrastructure including pipeline systems. LLNL conducted broadly scoped, well-integrated analyses and provided recommendations to the infrastructure owners, which led to substantial cost savings while improving public safety.^{101/}

Cyber Security: In 1989, the Department of Energy (DOE) established the Computer Incident Advisory Capability (CIAC) at LLNL to protect the vital information security infrastructure of the DOE, its laboratories, and plants. CIAC was only the second such cyber incident response center established by any U.S. government agency. Since then, CIAC's mission has evolved to assist other agencies and industry, and the DOE's investment in CIAC has topped \$150 million. LLNL also has a \$30 million per year program to assist government agencies in detecting, responding to, and preventing computer network attacks. This effort is focused on virtual network modeling and software analysis using high-performance computing. LLNL researchers also developed and continue to improve a suite of sophisticated network analysis tools that, through CES-21, can be adapted and applied to protect the IOUs and their customers.^{102/}

Gas Systems: Today's natural gas systems are composed of pipelines and components of varying ages and materials. In some cases, the physical characteristics and locations of the pipelines and components are unknown. To ensure the safety of these systems, utilities are improving the tools they use to document, model, test, and operate them. This is a challenging endeavor, particularly with the added reliance on the natural gas system to supplement intermittent renewable generation resources. Capabilities at LLNL are being applied to critical

^{101/} *Id.*, p.2-7.

^{102/} *Id.*

elements of this problem. One example is the modeling of natural gas systems. The models used by the utilities (specifically PG&E) are currently designed to evaluate backbone, transmission, and distribution systems separately, making an evaluation of the full effect of pressure transients or extreme operational events, such as pipeline failures, more difficult and less accurate. LLNL is bringing HPC tools to this problem, adding accuracy and versatility in the process. Using an HPC-powered system model developed by the Laboratory and industry partners, utility managers will be able to model the entire system from the backbone to the distribution lines and thereby fully simulate many different scenarios. These new capabilities greatly improve the safety and reliability of gas system operations. LLNL also has technical capabilities in pipeline leak detection and pipeline integrity assessment. These include rapid three-dimensional mapping using ground-penetrating radar and HPC-enabled structural mechanics modeling and simulation codes, which are used to anticipate the strength and performance of aging materials in critical infrastructure.^{103/}

As the testimony and record amply demonstrate, the resources, staffing and facilities that LLNL will bring to CES-21, particularly the High-Performance Computing facilities, will provide the Joint Utilities and California with world-class RD&D support for the CES-21 projects and program.

V. THE GOVERNANCE PROCESS FOR CES-21 WILL BE OPEN AND CONSENSUAL, PROTECT THE INTERESTS OF UTILITY CUSTOMERS, AND ENSURE THAT THE COMMISSION CAN OVERSEE THE CES-21 PROGRAM AND EXPENDITURES CONSISTENT WITH COMMISSION PRECEDENTS

In support of CES-21, the Joint Utilities presented extensive testimony showing that CES-21 expenditures and projects would be subject to an open and consensual governance process, including direct participation by the Commission itself in the investment planning and budget decisions of the program.^{104/}

^{103/} *Id.*, pp. 2-7- 2-8.

^{104/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 1-12- 1-15; Exhibit U-2, Joint Utilities' Supplemental Testimony, pp. 1- 5; Exhibit U-3, Joint Utilities' Rebuttal Testimony, pp. 1-8- 1-16.

The CES-21 governance process proposed by the Joint Utilities includes the following key elements which meet – and in several respects, exceed – the governance and Commission oversight requirements for utility energy RD&D:

- The CES-21 Project will be governed by a Board of Directors consisting of voting members from each of the Joint Utilities, the CPUC, and a member from academia appointed by the CPUC in a public process after consultation with the Energy Commission and relevant leaders from California research and academic institutions. In addition, non-voting members from the Energy Commission and CAISO will be included. The Board of Directors will be independent of LLNL and other potential providers of services under CES-21.^{105/}
- The meetings of the Board of Directors will be open to the public and subject to public access in the same way as meetings of other California public agencies.^{106/}
- Prior to expending any funds authorized by this Application, the Joint Utilities and LLNL will negotiate and enter into a Cooperative Research and Development Agreement (CRADA), which will be consistent with the provisions in the CES-21 Application and subject to final approval by the Board of Directors for the CES-21. The services provided by LLNL under the CRADA, which will be a five-year agreement, will be subject to the standards under the CRADA and U.S. Department of Energy (DOE) regulations for CRADAs, including the right of the Joint Utilities to perform audits of LLNL’s performance and to withhold payments for non-performance or default on a specific work order, as provided under CRADA regulations.^{107/}

^{105/} Exhibit U-2, Joint Utilities’ Supplemental Testimony, p. 1- 2; Exhibit U-3, Joint Utilities’ Rebuttal Testimony, pp. 1-8- 1-13.

^{106/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 1-12.

^{107/} *Id.*

- The CES-21 Board of Directors will approve the scope of work and administration of the specific research projects funded by CES-21. The Board of Directors also will have the authority to select an executive director and staff recommended by LLNL to manage the project activities, and may appoint such technical and advisory committees as it deems appropriate to assist in the project activities.^{108/}
- In addition, the Board of Directors will approve a strategic plan, annual budgets, and allocation of staff and other resources to provide services under individual work orders requested by each utility (or jointly) and the proportional share of funding set forth in the Proposal. The Board of Directors will not have the authority to approve any new commitments or expenditures extending beyond the five-year term of the CRADA, or beyond the authority granted in this Application. All funding of projects to support the work orders, including procurement of equipment, facilities, tools, computer software and hardware, will be subject to approval by the Board of Directors.^{109/}

The Board of Directors will be responsible for each of the following governance tasks, as follows:

- ***Need for research.*** The Board will only approve and fund projects and services that meet a demonstrated need for the benefit of one or more of the utilities.^{110/}
- ***Avoidance of duplicative research or funding.*** The Board will evaluate projects or expenditures in order to limit duplication of already publicly available funding or research, such as research already funded under the EPIC program, the utilities' general rate cases, Smart Grid proceedings, Energy Efficiency and Demand Response portfolio proceedings, or other proceedings.^{111/}

^{108/} *Id.*

^{109/} *Id.*

^{110/} *Id.*, p. 1-13.

^{111/} *Id.*

- ***Competitive solicitation of services.*** The Board will evaluate whether LLNL is a competitive or unique source of services or projects, compared to other providers, before approving expenditures under the Application, using normal “sole source” procurement criteria. Toward that objective, the Board will evaluate projects or expenditures to determine whether other potential providers, such as other research institutions, should have an opportunity to offer services to the utilities comparable to those provided by LLNL under the Application.^{112/}
- ***Transparency and public oversight of costs, benefits, and deliverables.*** The Board will ensure that all services and projects funded by the CES-21 are subject to routine and periodic reporting by Board and oversight by the Commission, including making available the results and benefits of the research projects to interested parties as appropriate and consistent with ensuring that the benefits accrue primarily for the benefit of utility customers funding the research.^{113/}

The Administrative Law Judge asked the Joint Utilities to provide specific testimony on certain aspects of the proposed governance process.^{114/} This additional testimony provided further details on the CES-21 governance process, including the composition of the Board of Directors, the selection process for research projects, and the use of partnerships and expertise beyond LLNL and the Joint Utilities.^{115/}

^{112/} *Id.*

^{113/} *Id.*

^{114/} Administrative Law Judge’s Ruling, January 17, 2012, A.11-07-008.

^{115/} Exhibit U-2, Joint Utilities’ Supplemental Testimony.

Specifically, the Joint Utilities testified that representative board members would be senior level employees with expertise relevant to the planned research, and that the director representing academia would be selected by the CPUC through a public process with input from the Energy Commission and relevant California leaders from research centers and academia.^{116/}

The Joint Utilities clarified that it will be the responsibility of the Board of Directors representing the utilities, CPUC and academic experts to select projects that address critical energy issues facing utilities, and that are in the best interest of California utility customers. The Board will also appoint an Executive Director who will be responsible for overseeing the research development process, research initiatives and management of the CES-21 program. The appointment will be from candidate(s) recommended by LLNL. The Executive Director will work closely with the Board to ensure that the goals and objectives of the CES-21 program are achieved and that projects carefully reviewed and selected.^{117/}

The Joint Utilities also clarified that a business case will be developed and documented for every project. The business case will assess: (1) need for the research; (2) research goals and desired results; (3) similar research performed by others to date; (4) avoidance of duplicative research; (5) competitive alternatives to the provision of services from LLNL; (6) partnership opportunities with outside experts; (7) deliverables and milestones; (8) cost, staffing requirements and responsibilities; and (9) benefits to gas and electric customers.^{118/}

The Board will be responsible for reviewing and approving each business case, with advice from a technical advisory committee or committees appointed by the Board to draw upon additional research and subject matter expertise outside the CES-21 Project team. The Joint Utilities also recommended that the Division of Ratepayer Advocates and The Utility Reform

^{116/} *Id.*, pp. 1- 2.

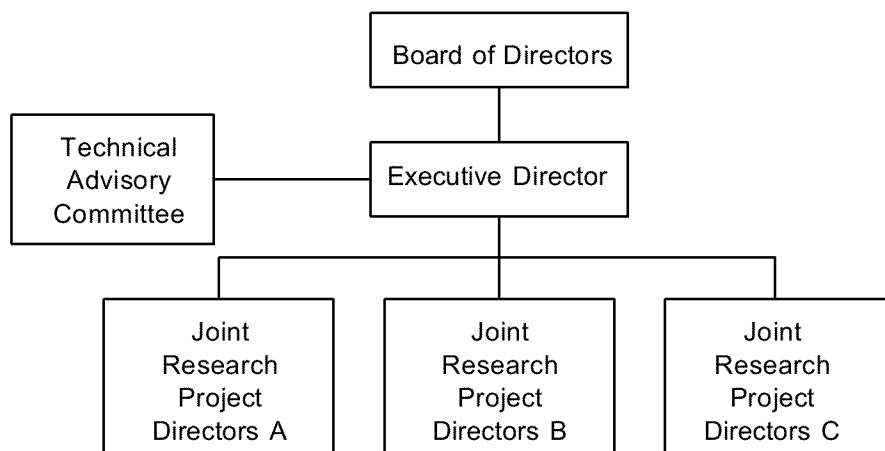
^{117/} *Id.*, p. 2.

^{118/} *Id.*, pp. 2- 3.

Network be invited to participate as ex officio members on the technical advisory committee. This will allow consumer representatives to provide direct input into the development of the business cases and the selection of research projects.^{119/}

Furthermore, a Research Director will be identified from LLNL's staff for every proposed research project. The Research Director will be responsible for developing a high quality business case proposal and for the management of the overall research once it is approved by the Board. There will also be a utility sponsoring manager or officer and utility Project Manager for each project. The Research Director will coordinate closely with the appropriate utility sponsoring manager or officer and utility Project Manager to ensure the goals and objectives of the research are cost-effectively and timely met. All projects will be monitored and tracked by the Board on a quarterly basis.^{120/} The governance structure is illustrated below.^{121/}

**FIGURE 2
PACIFIC GAS AND ELECTRIC COMPANY**



^{119/} *Id.*

^{120/} *Id.*, p. 3.

^{121/} *Id.*, p. 4.

The Joint Utilities also clarified that the Board will review projects in the context of an overall strategic plan and annual budget that will be developed to guide investments and expenditures. One goal of this plan will be to ensure that there is a balanced portfolio of high value research to meet needs across major research areas, such as Cyber Security, Electric Resource Planning and Electric and Gas System Operations.^{122/}

Finally, the Joint Utilities clarified in their supplemental testimony that CES-21 will seek to obtain access and foster private/public partnerships between outside experts and LLNL, the Joint Utilities, and other California energy and environmental policymakers. These experts may be affiliated with universities (e.g., University of California system, Stanford, the California State University system, Massachusetts Institute of Technology), California and other 13 research centers (e.g., Lawrence Berkeley National Lab, Electric Power Research Institute, National Renewable Energy Laboratory, Pacific Northwest National Laboratory), industry, engineering/consulting firms and other entities. An assessment of the availability and access to additional expertise will be performed as part of the business case for every proposed research project. The Board will carefully review this element of the business case to ensure that full advantage is taken of partnership opportunities and available outside expertise. One of the roles of the member of the Board representing academia will be to focus on this very issue and act as a liaison with the major sources of research expertise available to support each project.^{123/}

Once the research project is approved, the research team will collaborate with the outside experts and participating research centers or academic institutions and involve them in the research as appropriate and to varying degrees, on a project by project basis. The goal will be to put together the best research team possible to achieve each project's objectives at lowest cost.

^{122/} *Id.*, p. 4.

^{123/} *Id.*

Partnering and leveraging the expertise of outside experts and California’s renowned research centers and academic institutions will be central to achieving this goal.^{124/}

All equipment, tools, facilities, computer software and hardware, and other tangible and intangible assets, including patents, trademarks, copyrights and other intellectual property, that are procured or developed using the funding for the applied research and development element of the CRADA will be owned by the IOUs for the benefit of their customers in accordance with a joint ownership arrangement among the Joint Utilities. To the extent feasible, information generated by the CES-21 Project may be shared publicly, given the nature and objectives of the individual projects. The Joint Utilities intend that intellectual property developed using utility customer funds under CES-21 will be retained by the utilities as intangible utility assets, subject to the jurisdiction of the Commission and used for the benefit of utility customers unless the Commission approves the transfer or disposition of the assets, consistent with the Commission’s existing rules for allocation of the gain or loss on sale of utility assets. This approach is fair to ratepayers, consistent with the Public Utilities Code, and in the public interest.^{125/}

This governance process is comparable to the process used by leading research institutions, laboratories and governmental agencies, such as the U.S. DOE and National Science Foundation, as well as private research entities such as the Electric Power Research Institute, in that it provides for maximum access and consideration of a wide range of potentially worthy projects, while at the same time ensuring the strategic goals of the research program are incorporated as specifically as possible into the solicitation of proposals for projects to fund.^{126/}

The CES-21 governance process is not ground breaking. It is comparable to the governance process approved by the Commission when it established the Stewardship

^{124/} *Id.*, pp. 4- 5.

^{125/} Exhibit U-1, Joint Utilities’ Direct Testimony, p. 1-14.

^{126/} *Id.*, pp. 1-13- 1-14.

Council.^{127/} The Stewardship Council’s governing board has successfully carried out the responsibilities delegated to it by the Commission. In a similar manner, the Joint Utilities have proposed that a governing board be responsible for carrying out the goals and objectives of the CES-21 research agenda proposed to the Commission.^{128/}

The governance process proposed for CES-21 is precise and detailed, and in many respects exceeds the governance process adopted by the Commission earlier this year for energy RD&D expenditures under the Electric Program Investment Charge (EPIC) program.^{129/} For example, under CES-21, the Commission and other non-utility policymakers such as the Energy Commission and CAISO, will participate directly and actively in CES-21 planning and funding decisions, unlike the “once-every-three-years” EPIC planning process.^{130/} Likewise, the CES-21 governance process will require documented annual budget plans and project business cases approved by the CES-21 Board, unlike EPIC, which only requires approval of a three-year “investment plan” and then leaves to the discretion of the Energy Commission or individual utility the annual budgeting and project-specific reviews and decisions.^{131/} Finally, unlike the EPIC program, under which the three utilities and the Energy Commission will conduct separate energy RD&D programs, CES-21 will provide for a highly coordinated and collaborative RD&D program conducted jointly by the three utilities and LLNL, with direct participation by the CPUC, Energy Commission and CAISO in the decision-making and execution of the projects under the coordinated program.^{132/}

^{127/} D.03-12-035, Appendix C, Section 17.

^{128/} Tr., Vol. 1, pp. 8- 9, 12- 13 (PG&E/Cherry).

^{129/} D.12-05-037, pp. 22- 32 and Ordering Paragraph 12, pp. 102- 104.

^{130/} D.12-05-037, pp. 28- 32.

^{131/} *Id.*

^{132/} *Id.*

As discussed above, the Joint Utilities have proposed a robust, detailed and credible governance process that fully protects the interests of customers and ensures that the Commission can directly oversee, audit and regulate all aspects of the CES-21 program and expenditures. This governance process not only meets, but also exceeds, the criteria and standards the Commission has applied to utility energy RD&D expenditures and programs.

VI. THE CES-21 FUNDING LEVEL IS REASONABLE IN LIGHT OF FUTURE NEEDS, HISTORICAL UTILITY RD&D FUNDING AND THE RD&D FUNDING “GAP” IDENTIFIED BY THE COMMISSION AND CALIFORNIA POLICYMAKERS

The proposed funding level for CES-21 is a maximum of \$150 million over 5 years, spread among all three of the Joint Utilities.^{133/} This works out to an average of \$30 million per year, also spread among all the Joint Utilities. In this context, and given the critical and ambitious energy and environmental challenges that California faces over the next decade, \$30 million per year is very reasonable.

First, the Commission itself has identified a significant “gap” or shortfall in energy R&D investment and spending in the State. The Commission staff in the EPIC proceeding quantified this “gap” as follows:

As noted by NRDC, et. al. in comments on the Order Instituting Rulemaking (OIR) that opened the instant proceeding, a study by the American Energy Innovation Council indicates that the average spending on research and development activities across U.S. industries is about 3.5% of revenues. By this standard, even with the amounts recommended below, electric industry R&D efforts using utility ratepayer funding would remain significantly underfunded. Using 2010 data and applying 3.5% of operating revenues as a benchmark, the amount of R&D spending that would need to be undertaken in order for utility R&D spending (including that spent by the State but collected from ratepayers) be at the average amount across industries would be on the order of \$810 million per year. Staff estimates that the combined research, development and demonstration spending from both PGC and non-PGC sources in 2010 to be approximately \$140 million, or only about 17% of this amount.^{134/}

^{133/} Exhibit U-1, Joint Utilities’ Direct Testimony, pp. 3-1- 3-3.

^{134/} Staff Proposal, Electric Program Investment Charge, CPUC R.11-10-003, February 10, 2012, p. 17.

Second, the scope of R&D work needed in California and that CES-21 can support is large.^{135/} The objective of CES-21 is to provide advanced tools and analyses in the areas of priority identified in California’s energy and environmental policies, including, *inter alia*, Cyber Security, Electric Resource Planning, Electric and Gas System Operations, and Cyber Security, to help California achieve its long-term energy and environmental goals. These topical areas cover a broad array of issues and help explain why a funding level of \$150 million is justified. The CES-21 5-year combined funding level of \$150 million is a reasonable and conservative amount of funding to request from customers given the strategic importance of the issues to be addressed and the long-term customer benefits that may be realized. This R&D investment will also be leveraged with funding from federal and state government and other sources to the greatest extent possible. As described in Dr. Friedmann’s testimony, LLNL is leveraging billions of dollars of investments by the U.S. government over many years to provide the Joint Utilities with tremendous value and access to services such as high performance computing facilities at competitive prices.^{136/}

More important than the maximum funding level itself, the CES-21 governance process will ensure that only needed projects are funded and that the potential benefits of every research project are sufficient to justify its cost. If the Board of Directors—including the Commission’s representative—determines that the benefits of a particular project are not sufficient to justify the research project, the project will not be approved. For example, as noted in the Joint Utilities’ testimony, if the CES-21 project only modestly improves the planning of load following requirements among the Joint Utilities, it could save customers over \$30 million per year.^{137/}

^{135/} Exhibit U-1, Joint Utilities’ Direct Testimony, pp. 1-1- 1-3; D.12-05-037, pp. 12-14; *Electric Program Investment Charge, Staff Proposal*, R.11-10-003, February 10, 2012, pp. 9- 17; Exhibit U-3, Joint Utilities’ Rebuttal Testimony, p.1-6.

^{136/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, pp. 2-1- 2-8.

^{137/} Exhibit U-3, Joint Utilities’ Rebuttal Testimony, p. 3-4.

Similarly, if CES-21 improves the estimate of resource needs for renewables integration, it could save customers more than \$500 million in costs.^{138/}

VII. THE JOINT UTILITIES' PROPOSALS FOR COST RECOVERY AND COST ALLOCATION ARE REASONABLE AND CONSISTENT WITH COMMISSION RATEMAKING PRINCIPLES

A. The CES-21 Project Costs Are Allocated To The Joint Utilities Based On Pre-Determined Percentages

As indicated in the Joint Utilities' testimony, the total costs for the CES-1 project will be, over a five-year period, a maximum of \$150 million in funding for both internal utility administrative costs and Cooperative Research and Development Agreement costs, including a maximum of \$52 million to be potentially allocated to the LLNL High Performing Computing Innovation Center.^{139/} As stated in the Joint Utilities' testimony, these figures are maximum costs. Projects must be approved by the Board of Directors, and a utility's funding responsibility is limited to those projects the utility approves.^{140/} If all three utilities agree to a project approved by the Board of Directors, the cost for the project is allocated among the utilities based on pre-determined percentages. The pre-determined percentages are 55 percent, 35 percent, and 10 percent for PG&E, SCE, and SDG&E, respectively.^{141/} If a utility does not approve a project, the project may go forward as a non-joint project, subject to approval by the Board of Directors. The participating utilities that want to go forward with the non-joint project without funding from the non-participating utility will negotiate their respective funding percentages for the non-joint project, subject to approval of the Board of Directors.^{142/}

^{138/} *Id.*, p. 3-5.

^{139/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 3-1.

^{140/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 3-1 to 3-2. Tr., Vol. 1, p. 142 (SCE, Snow).

^{141/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 3-1.

^{142/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 3-2; Tr., Vol. 1, pp. 146-147 (SCE, Snow).

B. The Joint Utilities Request CPUC Approval For Full Recovery Of All Forecast Costs Without Subsequent Reasonableness Review, Consistent with Traditional Cost of Service Ratemaking

In this application, the Joint Utilities are specifically requesting a finding by the Commission that the funding requested in this application is expressly conditioned on full recovery of all verified costs in rates without further reasonableness review or restriction.^{143/} In response to DRA's concern that the Commission was not being given a full opportunity to approve the CES-21 scope or forecasted costs, the Joint Utilities confirmed that through this application, they are seeking the CPUC's review of the forecasted costs (which are a maximum of \$150 million over five years, subject to the percentages and restrictions discussed above) and scope.^{144/} This review would include the Commission's review of the application as a whole, including the types of projects that will be involved, the governance process, and the type of expenditures that the utilities are requesting, etc.^{145/} By seeking this review of the scope and the forecasted costs up front in this application, if the Joint Utilities incur costs that are consistent with the scope and costs adopted by the Commission through this application, there should not be an after-the-fact reasonableness review.^{146/}

C. CES-21 Project Costs Should Be Collected Through Distribution Rates, Except For Projects That Are Generation-Related

The Joint Utilities disagree with DRA's proposal that pursuant to Public Utilities Code Section 381(a) and (b), CES-21 costs should be allocated to all customers classes on an equal cents per kilowatt-hour (kWh) basis.^{147/} As indicated in the Joint Utilities' testimony, Public Utilities Code Section 381(a) and (b) apply only to the RD&D programs mandated by Assembly

^{143/} Exhibit U-1, Joint Utilities' Direct Testimony, p. 3-2.

^{144/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-1.

^{145/} Tr., Vol. 1, p. 151 (SCE, Snow).

^{146/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-1.

^{147/} Exhibit DRA-1, DRA's Direct Testimony, p. 1-5.

Bill 1890, which were recovered through the Public Goods Charge.^{148/} Public Goods Charge funding expired at the end of 2011, and thus is not applicable to the utilities' application.^{149/}

Instead, the Joint Utilities propose that CES-21 project revenue requirements be collected from all customers who receive delivery service through distribution rates and allocated in the same manner as rates for other electric distribution revenue requirements.^{150/} First, the Joint Utilities have always recovered IOU-administered RD&D program costs through their general rate cases in distribution rates.^{151/} Second, expected CES-21 projects (such as those relating to cyber security, resource planning, system operations, and workforce preparedness) benefit all customers on our system, and thus it is appropriate for all customers (bundled and direct access) to share in project costs through distribution rates.^{152/} To the extent that a CES-21 project is generation-related, the Joint Utilities do not take issue with TURN's proposal to allocate the generation-related cost using generation-based allocation factors, but with the cost recovery through distribution rates.^{153/}

D. Summary of the Joint Utilities Cost Recovery Proposals

The Joint Utilities' respective cost recovery proposals are discussed on pages 3-3 through 3-4 of their direct testimony submitted in this proceeding and are summarized below:

1. PG&E's CES-21 Cost Recovery Proposal

PG&E proposes to recover its annual CES-21 revenue requirement through its existing electricity and gas rate structures, subject to annual true-up. The actual amounts charged to

^{148/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-3.

^{149/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-3.

^{150/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-2.

^{151/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-3.

^{152/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, p. 4-2.

^{153/} Exhibit U-3, Joint Utilities' Rebuttal Testimony, pp. 4-2 to 4-3; Tr., Vol. 1, p. 139 (SCE, Snow).

electric and gas customers will reflect projects approved by the Board of Directors. PG&E forecasts that 75 percent of its project cost share will be electric-related project costs and 25 percent will be gas-related project costs. The electric revenue requirements will be collected from electric distribution customers through PG&E's electric distribution rate and recovered in the Distribution Revenue Adjustment Mechanism. Electric rates to collect these amounts will be set in the same manner as rates for other electric distribution revenue. Gas revenue requirements will be recovered in the Core Fixed Cost Account for core gas customers and the Noncore Customer Class Charge Account for noncore gas customers. Gas rates to collect these amounts will be set in the same manner as rates for other gas transportation and distribution revenue.^{154/}

2. SCE's CES-21 Cost Recovery Proposal

SCE proposes to recover its annual revenue requirement from all customers who receive delivery services through SCE's distribution rates and will be recovered through the Base Revenue Requirement Balancing Account ("BRRBA").^{155/} Electric rates reflecting the amounts recorded in the BRRBA will be set in the same manner as rates for other distribution revenue requirements. In accordance with current SCE ratemaking practices, the December 31 balance recorded in the BRRBA will be consolidated into rate levels, on, or soon after, January 1 of each subsequent year as part of SCE's annual Energy Resource Recovery Account ("ERRA") Forecasting proceeding.^{156/} Although SCE's cost recovery will not be subject to any reasonableness review, the recorded operation of the BRRBA will be reviewed in SCE's annual ERRA Reasonableness application to ensure that the costs recorded are stated correctly and are consistent with a final decision issued in this proceeding.^{157/}

^{154/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 3-3- 3-4.

^{155/} Exhibit U-1, Joint Utilities Direct Testimony, p. 3-4.

^{156/} Exhibit U-1, Joint Utilities Direct Testimony, p. 3-4; Tr., Vol. 1, p. 141 (SCE, Snow).

^{157/} Exhibit U-1, Joint Utilities Direct Testimony, p. 3-4.

3. SDG&E's CES-21 Cost Recovery Proposal

SDG&E proposes to recover its annual revenue requirements through its existing electricity rate structures, subject to annual true-up. Electric rates to collect these amounts will be set in the same manner as rates for other electric distribution revenue. Specifically, SDG&E proposes to recover costs through the same rate design currently authorized for the recovery of other program related costs such as the Self-generation Incentive Program and the California Solar Initiative currently recovered through distribution rates. Through CES-21 application, SDG&E requests the authority to open a Balancing Account to record the difference between its share of the program expenses up to the maximum, and its annual revenue requirement. The disposition of this account would be addressed at SDG&E's annual Electric Regulatory Account Balance Update filing, or other applicable proceeding as directed by the Commission, to be collected from electric distribution customers through SDG&E's electric distribution rates.^{158/}

VIII. CONCLUSION – CES-21 IS REASONABLE, IN THE PUBLIC INTEREST, AND SHOULD BE APPROVED

The CES-21 potential benefits are real and probable, and not hypothetical or theoretical. The priorities for CES-21 are already “cutting edge” priorities and energy challenges that desperately need additional funding and focus in order to meet the energy challenges identified in the California Energy Plan by the Commission along with the California Energy Commission (CEC), California Independent System Operator (CAISO), California Air Resources Board, and California Environmental Protection Agency.

More recently, the Commission has identified the same priorities for utility funded R&D goals and priorities in the EPIC and Smart Grid proceedings and decisions. Likewise, the need to develop and implement new technologies and tools to enhance natural gas pipeline safety is currently “front and center” in several Commission proceedings addressing the San Bruno pipeline tragedy.

^{158/} Exhibit U-1, Joint Utilities' Direct Testimony, pp. 3-4- 3-5.

From the perspective of utility customers who depend on the utilities to provide safe, reliable, clean and cost-effective electric and natural gas service, there is a pressing need for the Joint Utilities to actively pursue R&D to spur innovation and develop practical solutions to solve the daunting energy challenges faced in California.

For too long, California and the Joint Utilities have not made needed investments in pragmatic, applied R&D. For too long, the Joint Utilities have been insular about pursuing alternative approaches to conducting R&D and implementing “cutting edge” technologies that hold the potential for large gains in efficiency and improvements in customer safety, reliability and service.

As described by LLNL Chief Energy Technologist Friedmann in his expert testimony, LLNL clearly has strong technological capabilities that will be useful in meeting and surmounting all these technological challenges to California’s energy future.

CES-21 is a unique collaborative effort among the Joint Utilities and LLNL, a world-renowned research institution, as well as the CPUC, Energy Commission and CAISO, to look beyond the traditional ways in which utilities have strived to improve performance and to explore new ways of solving the complex energy challenges facing California—whether those challenges relate to the integration of renewable resources, the safety of our gas and electric systems or the security of our customers against cyber attacks on the electricity grid and natural gas pipelines that serve them.

California’s energy utility industry is fundamental to its economic growth and prosperity. CES-21 is forward-looking, outwardly-focused public-private partnership that is needed to ensure the long-run success of California’s electric and natural gas industries and the State’s future economic growth, competitiveness, and quality of life. Moreover, as discussed in the governance section of this brief, the Joint Utilities have proposed an appropriate level of Commission oversight to ensure that the interests of utility customers are fully and openly protected and represented.

CES-21 is a sound investment in the future for the benefit of utility customers and California. The Commission should approve CES-21.

Respectfully Submitted this 20th day of July, 2012,

CHRISTOPHER J. WARNER

By: _____ /s/
CHRISTOPHER J. WARNER

Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94105
Telephone: (415) 973-6695
Facsimile: (415) 973-0516
E-Mail: CJW5@pge.com

Attorney for
PACIFIC GAS AND ELECTRIC COMPANY

San Diego Gas & Electric Company,
101 Ash Street
San Diego, California 92101-3017
Telephone: (619) 699-5162
Facsimile: (619) 699-5027
E-Mail: ATrial@semprautilities.com

Attorney for
San Diego Gas & Electric Company

By _____ /s/ Allen K. Trial
ALLEN K. TRIAL

Southern California Edison Company
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770
Telephone: (626) 302-6879
Facsimile: (626) 302-3990
E-Mail: walker.matthews@sce.com

Attorney for
SOUTHERN CALIFORNIA EDISON COMPANY

By _____ /s/ Walker A. Matthews, III
WALKER A. MATTHEWS, III

Dated: July 20, 2012

CERTIFICATE OF SERVICE BY ELECTRONIC MAIL

I, the undersigned, state that I am a citizen of the United States and am employed in the City and County of San Francisco; that I am over the age of eighteen (18) years and not a party to the within cause; and that my business address is 77 Beale Street, San Francisco, California 94105.

I am readily familiar with the business practice of Pacific Gas and Electric Company for collection and processing of correspondence for mailing with the United States Postal Service. In the ordinary course of business, correspondence is deposited with the United States Postal Service the same day it is submitted for mailing.

On July 20, 2012, I served a true copy of:

OPENING BRIEF OF PACIFIC GAS AND ELECTRIC COMPANY (PG&E) (U 39 M), SAN DIEGO GAS & ELECTRIC COMPANY (SDG&E) (U 902 E), AND SOUTHERN CALIFORNIA EDISON COMPANY (SCE) (U 338 E)

[XX] By Electronic Mail – serving the enclosed via e-mail transmission to each of the parties listed on the official service list for **A.11-07-008** with an email address.

[XX] By U.S. Mail – by placing the enclosed for collection and mailing, in the course of ordinary business practice, with other correspondence of Pacific Gas and Electric Company, enclosed in a sealed envelope, with postage fully prepaid, addressed to those parties listed on the official service list for **A.11-07-008** without an e-mail address.

And the following individual by hand delivery:

ALJ Timothy J. Sullivan
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

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

Executed in San Francisco, California on July 20, 2012.

/s/
MARTIE WAY