Title of Proposed Initiative (Short and concise): Performance Metrics and Operational Performance Data for Low-Energy Integrated Building Systems

Investment Areas (Check one or more) – *For definitions, see First Triennial Investment Plan, page 12*:

☒ Applied Research and Development

☒ Technology Demonstration and Deployment

☐ Market Facilitation

Electricity System Value Chain (**Check only one**): *See CPUC Decision 12-05-037, Ordering Paragraph 12.a. http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF.*

☐ Grid operations/market design

☐ Generation

☐ Transmission

☐ Distribution

☒ Demand-side management

California Energy Commission
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Issues and Barriers:

California has aggressive goals for low-energy, net zero buildings. However, building designers have to specify the performance of components. There is a need to integrate the performance of windows, electric lighting, and daylighting as a system. Such a performance specification calls for system-level rather than device-level energy performance.

Some in the lighting industry (ALA, IES) are already struggling to devise a more robust energy performance metric that can: a) replace lighting-power-density-plus-specified-controls (as the lighting efficiency requirement in building codes); b) complement luminaire [target] efficacy at the device level; c) incorporate both natural and artificial daylight sources; and d) account for actual visual performance and lighting quality/comfort/aesthetics associated with occupancy schedules, preference, and task requirements.

This combination of integrated low-energy building systems needs R&D to develop the appropriate metrics and needs careful thought. The related goal is how to ensure that when these systems are installed that the performance as intended. To achieve this additional goal will require new techniques for continuous measurement. The lighting end-use electric circuits required in the new building codes will be the source of new data for continuous low-energy operational platforms.

Initiative Description and Purpose:

This technology and integrated system research will help California achieve low-energy commercial buildings. This information will help California move toward performance –based codes. Performance must be better described. We need integrated end-use systems that consider the building as part of the system. Lighting end-use data needs to consider the system it is installed within. There is a need for component specs, such as window properties, daylighting systems, electric lighting systems, and controls to be organized and described as an integrated system.

Stakeholders:

Stakeholders include the R&D teams – labs, academics, and consultants. Manufacturers and are another stakeholder. Design teams and utility DSM planners are stakeholders. Finally, the stakeholders are building owners, tenants, and operators.

Background and the State-of-the-Art:

- What research development and demonstration has been done or is currently being done to advance this technology or strategy (cite past research as applicable)?
  - Researchers have been evaluating the performance and properties of advanced windows and window systems such as electrochromic windows, and automatically controlled shutters and blinds. One California test lab simulates real-world office spaces. Embedded instrumentation throughout the lab records solar gains and losses for specified time periods, weather conditions, energy use, and human comfort indicators.
  - One feature of this work has been to evaluate automatic mechanical shading systems that are on the market now. Better knowledge about their performance and how to control them for optimum building energy efficiency and human comfort could help expand their use in buildings.
  - Further work is needed to extend this work into models to evaluate how this technology can be used in advanced building codes and to ensure that the building system performs as intended.

- Describe any public and/or private successes and failures the technology or strategy has encountered in its path through the energy innovation pipeline: lab-scale testing, pilot-scale testing, pre-commercial demonstration, commercial scale deployment, market research, workforce development.
  - Work is needed in all of the phases of the R&D pipeline mentioned above. New test beds offer exciting new capabilities to conduct this work. Similarly, further research is needed to ensure that this technology is considered in both new building designs and retrofits is to ensure that the existing models can adequately model the features of this technology. Finally, new low-cost measurement and control systems are needed to ensure that energy use is minimized

- Identify other related programs and initiatives that deal with the proposed technology or strategy, such as state and federal programs or funding initiatives (DOE, ARPA-E, etc.).
  - New R&D test facilities are available to evaluate new technologies and better understand how advanced low energy building systems can be operated as an integrated systems.

Justification:

Describe how this technology or strategy will provide California IOU electric ratepayer benefits and provide any estimates of quantified annual savings/benefits in California, including:

- Name of sector and estimated size and energy use.
  - This initiative is for commercial buildings, which represent nearly 5000 GWh/year. (California consumes over 14,000 GWh of electricity alone. Buildings use about 70% of the electricity, with commercial buildings responsible for about half of that 70%).
- Quantifiable performance improvements for the proposed technology/strategy.
  - The performance improvement is to cut lighting energy use in half in half of the stock.
- Maximum market potential, if successful.

  This approach has the potential for about half of the commercial building stock. This system is not of interest to facades with minimal windows such as some of the Big Box Retail but is applicable to office buildings, schools, warehouses, strip retail, and many other commercial building types.
- Number of direct jobs created in California.
  - This initiative has the potential to create hundreds of jobs in California related to the accelerated retrofit concepts that this initiative.
- Why this research is appropriate for public funding.
  - This research is appropriate for public funding because it is general in nature. It will create critical advanced building performance metrics needed for the buildings industry to continue to achieve aggressive cost-effective retrofits.

Ratepayer Benefits (Check one or more)**:**

☒ Promote greater reliability

☒ Potential energy and cost savings

☐ Increased safety

☒ Societal benefits

☒ Environmental benefits - specify

☒ GHG emissions mitigation/adaptation in the electricity sector at the lowest possible cost

☐ Low emission vehicles/transportation

☐ Waste reduction

☒ Economic development

Describe specific benefits (qualitative and quantitative) of the proposed initiative

Public Utilities Code Sections 740.1 and 8360:

Please describe how this technology or strategy addresses the principles articulated in California Public Utilities Code Sections 740.1 and 8360. The California Public Utilities Code is available online at www.leginfo.ca.gov/cgi-bin/calawquery?codesection=puc.