

EPIC TRIENNIAL INVESTMENT PLAN 2015-17**Proposed Energy Research Initiative
Questionnaire**

Title of Proposed Initiative: Energy Efficient and Healthy Classrooms

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:

Schools represent a significant portion of the building stock, thus, California cannot meet its aggressive energy goals without reducing energy use in schools. California Proposition 39 will provide approximately \$2.75 B of funding over five years for energy retrofits of schools. Schools districts also are planning to implement retrofits using other sources of money. For example, the LA Unified school district will spend ~\$7 billion obtained from selling of bonds for retrofits of the district's schools. Based on discussions with school districts, most Proposition 39 funding will be used for retrofits that utilize well proven retrofit measures to obtain modest but cost effective energy savings. While helpful, these retrofits fall far short of the deeper energy retrofits needed to meet California's energy goals. The deeper retrofits will require that multiple synergistic retrofit measures be implemented. These energy retrofits can affect indoor environmental quality positively or negatively depending on the measures implemented. It is imperative that outdoor air ventilation rates are addressed when classrooms are retrofit. Data indicate that approximately half of classrooms in California have less outdoor air ventilation than required by Title 24 standards, and many have far less than the required minimum. Also, research has determined that student absence rates increase and student performance decreases when ventilation rates are low. Thus, current classroom environmental conditions are not conducive to maximization of student and teacher performance. Rate payers will benefit from addressing these issues as a result of the lower expenditure for energy in schools and improvements in the health and performance of students and teachers.

Initiative Description and Purpose:

The long term vision is for California's schools to become highly energy efficient while providing indoor environmental conditions that are healthy for students and teachers and that enable maximum student and teacher performance. Today, we are far from achieving that goal. A prerequisite to achieving this goal is to develop, test, demonstrate, and facilitate adoption of cost-effective packages of synergistic retrofit measures that are attractive to school districts and that can enable large energy savings with simultaneous improvements in indoor environmental quality. However, technical measures alone will be insufficient – facility managers, teachers, and students need to be motivated

and enabled to maximize energy savings while maintaining excellent indoor environmental quality. This is the broad goal of the proposed initiative. More specific objectives include:

- Identifying the largest energy efficiency opportunities in schools
- Identifying the causes of the widespread problem of inadequate ventilation in classrooms
- Developing cost-effective widely-usable innovative packages of synergistic retrofit measures, for different classroom types and climates
- Quantifying and demonstrating the energy savings, benefits to indoor environmental quality, and costs of these retrofits, and for reference assessing the same outcomes from the typical retrofits implemented today.
- Developing guidance and tools for school administrators, teachers and facility operators that enable them to make decisions and take actions consistent with the vision.
- Aggressively communicating and facilitating adoption of the retrofit package designs and associated guidance and tools in California.

Stakeholders:

In addition to electric ratepayers, stakeholders in this effort include school administrators, teachers, facility operators, the California Department of Education, California Division of State Architect, students, energy retrofit companies, energy policy makers, utilities, and non-profits addressing energy, climate change, schools, education, and health. To date, selected school districts and non-profits have been contacted and indicate their support for the vision. The proposed initiative needs to be implemented with participation from a these key stakeholders.

Background and the State-of-the-Art:

Numerous studies have investigated energy use and energy savings opportunities in classrooms and several organizations, including the CEC, have developed or are developing guidance for retrofits of schools supported by Proposition 39 funding or for design of new energy efficient schools. Also, prior projects have developed or investigated the potential of specific technical measures for schools, such as displacement ventilation, energy efficient lighting, and daylighting. Many utilities offer incentives and rebate programs to improve energy efficiency in schools.

In 2004, the California Air Resources Board published a final report from a survey of environmental conditions in a representative sample of public school classrooms in California. The study over-sampled relocatable classrooms, but also obtained much data from traditional classrooms and produced estimates of distributions of environmental conditions representative of the full stock of classrooms. This project is one source of the data, primarily indoor CO₂ data, indicating that ventilation rates in classrooms often fall far short of the minimum rates specified in Title 24. Acoustic and thermal comfort problems are also common. A more recent study of 160 classrooms from three districts in California by Lawrence Berkeley National Laboratory found the ventilation rates fell far short of requirements and that student illness absence increased when ventilation rates were low. Also numerous studies have shown that student performance, e.g., as measured by standard academic performance tests, is reduced when ventilation rates are low.

Most of the prior research has focused on energy efficiency or on indoor environmental quality, but not on their integration. Guidance available today focuses primarily on classroom energy savings with little or no attention given to environmental quality or to the associated widespread problem of insufficient ventilation. Also, existing guidance emphasizes individual retrofits, not the packages of synergistic retrofits needed to obtain deep energy savings most economically. The excellent guidance from the Collaborative for High Performance Schools (CHPS), focusing on new construction, does address indoor environmental quality, although, CHPS does not provide solutions for deep energy retrofits that address the classroom ventilation problem.

**Justification:**

This project will identify cost effective packages of retrofits that increase energy savings beyond the usual level, while also ensuring compliance with classroom ventilation standards and improving indoor environmental quality. California schools serve over 6.2 million students in over 10,000 buildings. The majority of this electricity is used to provide interior lighting, AC cooling, and mechanical ventilation. Reducing the energy use of California's schools by 50% of current use, compared to a reference energy savings of 30%, would result in additional annual energy cost savings of 1.2 billion dollars per year, and mitigate an additional 540 thousand metric tons of CO₂ annually. In addition, by bringing ventilation rates up to minimum requirements of current standards, the retrofit measures will reduce student absence rates and increase student performance. Based on analysis of Mendell et al. (Indoor Air Journal, 2013) increasing classroom VRs from the California average (~4 L/sec-person) to the State standard would decrease illness absence by 3.4%, and increase attendance-linked funding to schools by \$33 million annually. This initiative will benefit California ratepayers by reducing school energy costs, improving student and teacher health, and improving education, leading to a more educated, productive, and competitive workforce. This research is appropriate for public funding because it focuses on a public service (education), because the challenges and needs are large and not being met, because the benefits are largely accrued by the public ratepayers and their children, and because the private sector has little incentive to consider indoor environmental and energy in an integrated manner. The initiative will stimulate retrofits that lead to many jobs in California.

Ratepayer Benefits (See prior text for details.):

- 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

Public Utilities Code Sections 740.1 and 8360:

This initiative is consistent with guidelines in Section 740. The probability for benefits to ratepayers, and the magnitude of those benefits, are high. The initiative is unique and supports environmental improvement and public and employee safety (health). The initiative will improve operating efficiency of schools and reduce their operating costs.