



Title of Proposed Initiative: Advanced indoor air cleaning technologies and pollutant source controls

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

DOCKETED

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Issues and Barriers:

Achieving the State's goals on CO₂ emission reductions, zero-energy new buildings and more energy-efficient existing buildings will require major reductions in the energy used to ventilate with conditioned outdoor air (including air heated and cooled). Exposures to harmful indoor pollutants pose significant health risks that may be intensified by further reducing ventilation. Simultaneous improvements of indoor air quality (IAQ) and HVAC energy savings can be achieved by implementing cost-effective air cleaning technologies and indoor pollutant source control practices that enable a high level of indoor air quality to be maintained with less outdoor air ventilation. Rate payers will benefit from addressing these issues as a result of the lower expenditure for energy in residential and commercial buildings, and improvements in occupant health and performance.

Initiative Description and Purpose:

Today, building materials are key sources of indoor pollutants. A new generation of future building materials can become negligible sources and some, via incorporation of catalysts or other chemical functionalities, may be able to remove important pollutants, hence offering a net positive contribution to indoor air quality. Building materials manufacturers are actively pursuing this vision.

This initiative will develop and evaluate the performance of cost-effective pollutant removal technologies under realistic building conditions, with a focus on key indoor contaminants such as ozone, NO_x, formaldehyde and other volatile organic compounds (VOCs). Field demonstrations will be carried out in commercial and/or residential settings. Project(s) will develop low-emission building materials and HVAC air cleaning technologies that can be introduced in the market within the next five years. It will also support future reformulation of ventilation standards (e.g., Title 24) to enable higher energy savings by reducing the demand for outdoor air supply.

Stakeholders:

In addition to electric ratepayers, stakeholders in this effort include State agencies (CEC, ARB, CA Dept. of Public Health), Federal agencies (EPA, DOE) and various industries (chemical, air cleaning, filtration, building materials). The proposed initiative needs to be implemented with participation from all these key stakeholders.

Background and the State-of-the-Art:

While particle filtration is a mature technology, cost-effective solutions to remove VOCs are not available in the market. Some VOCs often drive the need for higher ventilation rates. While some technologies are at the demonstration stage, promising work is still in the early stages of the innovation pipeline (lab bench scale and early demonstration).

Over the past few years, projects funded by DOE, CEC, ARB and industry contributed to develop and characterize novel technologies to remove indoor pollutants. Work has focused on:

- a) optimizing the synthesis of catalysts and integration with sorbent materials and substrates,
- b) evaluating performance in laboratory bench-scale tests and limited room-size tests in the field
- c) characterizing emissions of undesired secondary pollutants

Indoor pollutant source control is another approach to reduce the demand for ventilation, heating and air conditioning while simultaneously improving indoor air quality. For example, the recently implemented California Air Resources Board's composite wood regulation is expected to reduce formaldehyde concentrations in new homes by up to 40%, from a median level of $36 \mu\text{g m}^{-3}$ found in a 2009 study of new California homes to an expected median formaldehyde level of about $22 \mu\text{g m}^{-3}$ in future homes. Several other similar approaches to remove harmful pollutant sources, comprising regulatory measures and the development of new materials, are currently being implemented.

Justification:

Almost all commercial buildings and homes in California use air conditioning and/or space heating equipment. From the ~ 1 quad/yr consumed by California residential and commercial buildings, almost half is used in space heating, cooling and ventilation energy. The proposed research will allow achieving critical validation milestones to support the development and commercialization of next-generation building materials and air cleaning technologies. In commercial buildings provided with mechanical ventilation and air conditioning, removing 20% of indoor pollutants enables approximately 50% reduction in energy consumed by ventilation, heating and air conditioning.

This initiative will benefit California ratepayers by reducing ventilation, heating and air conditioning energy costs, while improving building occupants' health and productivity. In occupational settings, these benefits will also conduce to a more competitive workforce. This research is appropriate for public funding because it focuses on public health and energy savings benefits, because the challenges and needs are large and not currently 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 technology innovations that can lead to jobs in California.

Ratepayer Benefits (See prior text for details.):

- Promote greater reliability

- Potential energy and cost savings
- Increased safety
- Societal benefits
- Environmental benefits – improved indoor air quality, reducing exposure to pollutants
- 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 safety (health). The initiative will improve operating efficiency of residential and commercial buildings, and will reduce their operating costs.