


Title of Proposed Initiative: Next-generation highly reflective building envelope surfaces
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:

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 cool buildings, particularly in climate regions with hot summers. The California Energy Commission's Title 24 mandates a minimum solar reflectance of 0.63 for aged low-sloped nonresidential roofs in all climate zones (CZ), of 0.55 for aged low-sloped residential roofs in CZ 13 and 15 and of 0.20 for aged steep residential roofs in CZ 10 - 15. Currently, even highly reflective building envelope materials can lose a significant fraction of their initial solar reflectance (albedo) over the first year after being installed, as a consequence of soiling and weathering. There is a need for a next-generation of envelope materials that are resistant to aging, and preserve their initially high solar reflectance over its lifetime. Widespread adoption of next-generation stay-clean materials may allow increasing the CEC Title 24 mandate from 0.55 – 0.63 to a solar reflectance of 0.70 – 0.75 or higher, thus enabling significant energy savings. A key barrier to the development of this next-generation of building envelope products is the lack of effective methods to evaluate and rate their long-term performance. 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 public health.

Initiative Description and Purpose:

This initiative intends to develop tools, methods and materials to assist industry in the manufacturing of next-generation building envelope products. Methods will include the quantification under standardized conditions of the aged solar reflectance of new materials. This method will allow identifying technologies with the highest potential to retain initially high cool roofing performances over the product lifetime. Project(s) will be carried out in collaboration with leading building envelope manufacturers, and will provide estimates of the energy savings attained by using next-generation materials in the State.

Stakeholders:

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

Background and the State-of-the-Art:

Light-colored surfaces offer the best initial cool roofing performance, but also suffer the largest losses in solar reflectance due to soiling and weathering, often within a year. Stay-clean surfaces can preserve the initially high solar reflectance of cool roofs and cool envelopes, thus enhancing energy savings. Several new technologies incorporate chemical additives and functionalities to the exterior surface of envelope materials to enhance their capacity to prevent soiling. The US Cool Roof Rating Council (CRRRC) established a methodology to rate new products released to the market by measuring their initial solar reflectance and thermal emittance, and repeating these measurements after three years of exposure in three different sites in the US (Florida, Arizona and Ohio). Similarly, the US EPA Energy Star® program also rates products using their initial and 3-year aged properties. Currently, efforts are underway to develop an accelerated aging methodology to rate products in a much shorter time frame. The information collected by the CRRRC and the US EPA, which comprises data collected for over 600 roofing products, strongly supports the need for next-generation stay-clean materials with enhanced resistance to soiling.

Justification:

Significant penetration of this technology into the US market could increase significantly the energy savings potential of cool roofs. We estimate a 50% boost in US cool roof energy cost savings (increasing lifetime present value to \$9.4B) if stay-clean properties raise the aged solar reflectance of white roofs to 0.70 – 0.75, which is substantially greater than the 0.55 aged solar reflectance typical today (and mandated for low-sloped roofs in California by Title 24).

More than 30% of the energy savings realized with white or clear-colored roofs can be lost over the first year of exposure due to reductions in solar reflectance caused by soiling and weathering. Deploying a next-generation of “stay-clean” building envelope materials can raise the aged solar reflectance of white roofs by 0.15 – 0.20 and increase annual energy savings by 50% (e.g., to 0.083 quad/y for U.S. commercial buildings in the two hottest climate zones, worth \$0.63B/y). Equivalent to removing 2.1 million cars from the road, installing such next-generation materials on roofs could eliminate the emission of up to 215 Mt CO₂ over 20 years.

This initiative will benefit California ratepayers by reducing air conditioning demand during hot summers in most of the State’s climates. In buildings without air conditioning, highly reflective roofs and building envelopes contribute to improving building occupants’ comfort and health. 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 in the building material manufacturing sector 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.