


**Title of Proposed Initiative: Low-Cost Advanced Building Insulation Materials**

**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](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**

**12-EPIC-01**

TN 72600

FEB 13 2014

**Issues and Barriers:**

20% to 30% of total electricity consumed by residential and commercial buildings in California is used for air conditioning and space heating. With insulation and air tightness being critical factors in the design of energy efficient buildings, the use of spray foam insulation is increasing in California and elsewhere due to its ability to restrict air movement as well as heat flow. However, higher performance insulation materials are needed to meet statewide efforts to reduce home energy consumption. In addition, the use of sustainable materials with reduced harmful chemical emissions (i.e. flame retardants, formaldehyde) is necessary to maintain healthy indoor environments for occupants. Existing high performance insulation materials (aerogels, vacuum insulated panels) are too expensive to compete with conventional insulation materials. There is a need to reduce costs of such advanced materials and/or to develop new materials that offer better performance while maintaining cost and reducing emissions.

**Initiative Description and Purpose:**

First, cost and benefit analysis of existing high performance insulation materials for retrofits and new construction in California is needed. We also need to estimate target cost(s) per material including labor and installation that would allow a significant market adoption of new high performance insulation materials. An important area of effort will be to conduct scientific research on the preparation, characterization and manufacturing of low-cost high performance materials for wall-cavity insulations with target performance of R-8 per inch or better. In addition, laboratory and demonstration tests are needed to compare long term thermal performance, mechanical properties, fire safety and permeability to moisture of new materials with conventional insulation products.

**Stakeholders:**

Chemical industry; Insulation manufacturers; Insulation contractors; CA homeowners; Energy efficiency programs and government agencies promoting better insulation (CEC, US Department of Energy).

## **Background and the State-of-the-Art:**

- The cost of commercial high performance insulation materials is many times higher than the price of traditional thermal insulations.
- Recent studies demonstrated the possibility of creating insulation materials with high thermal resistance at relatively low cost and using natural and sustainable materials.
- This innovative research is still at the bench-scale stage and we estimate that it would require 2-5 years to reach deployment phase. While the risk is high due to the innovative type of materials, the potential energy savings and impact on the insulation market are tremendous. In addition, similar approaches are being pursued in Europe to develop materials for insulation and the recent literature indicates that the feasibility of producing such materials is reasonable.
- This research has the potential to be a key component of the building technologies program at DOE due to its high potential of achieving significant energy savings in the US.

**Justification:**

If 20% of energy used in space heating and cooling could be reduced through better wall insulation, annual energy reductions of 0.03 Quad BTU could be achieved along with ~ \$ 1.3 B annual cost savings. This improvement can be reached by increasing the wall cavity insulation for existing and new buildings from the current minimum mandatory level of R-13 (CA Title 24) to a performance of R-30 while maintaining the same thickness. By innovating and developing new technologies for better insulation, this initiative will benefit many Californians as their annual energy bills may be reduced by 20% or more. It will also enhance US-based manufacturing capability and provide new job opportunities in California. This research is appropriate for public funding because it focuses on energy savings benefits, because the challenges and needs are large and not currently being met, and because the benefits are largely accrued by the public ratepayers.

**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:**

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 energy efficiency in buildings, new technologies and job creation. The initiative will improve operating efficiency of residential and commercial buildings, reduce peak energy loads, and will reduce their operating costs.