STATE OF CALIFORNIA

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

CALIFORNIA ENERGY COMMISSION

(This is a Request for Information only - Complete Pages 1 and 2 for each initiative)

Title of Proposed Initiative (Short and concise): Radiant System Design Guidelines and 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
12-EPIC-01
TN 72656
FEB 14 2014

Issues and Barriers:

Describe the issues and barriers that are impeding full market adoption of the proposed clean energy technology or strategy (such as cost, integration, or lack of information).

Interest and growth in radiant cooling and heating systems have increased in recent years because they have been shown to be energy efficient compared to all-air distribution systems. However, the building industry is largely unfamiliar with this technology, particularly in the U.S., leading to a wide range of design and operating solutions in California and other North American locations. There is a lack of standardized methods and guidelines for radiant system design and control available to the building industry.

Initiative Description and Purpose:

How will this technology or strategy help address the issue/issues? Describe knowledge to be advanced to overcome critical barriers. Include the recommended funding level (minimum and maximum) for each project under this initiative.

The goal of work under this research initiative will be to develop new guidance to support a significant increase and wider application of energy efficient radiant cooling and heating systems in both new and existing buildings. Laboratory and modeling research will be conducted to address gaps in our fundamental understanding of radiant systems and how they differ from conventional VAV air distribution system design, leading to new and improved design tools (both simplified tools and whole-building energy simulation programs). Using the improved modeling tools, as well as comprehensive field studies of exemplary California buildings using radiant systems, practical guidance and operating strategies will be tested, compared, and developed for inclusion in the project deliverable. Estimated funding for this effort is as follows: $750,000 - $1,000,000 per year over 3-5 years. Estimated breakdown by research activity is: lab studies = $350,000/year, field studies = $300,000/year, and simulation and modeling analysis = $350,000/year.

Stakeholders:

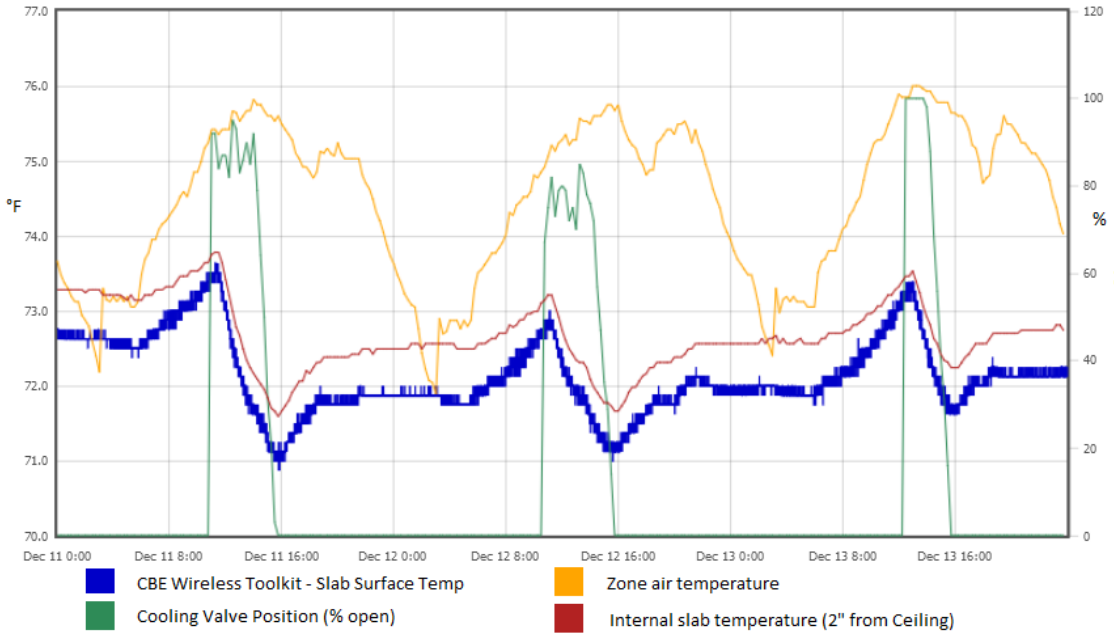
Identify the stakeholders who support the initiative.

Radiant systems have attracted a significant amount of interest among the professional design community. The long term impact of this initiative will be to support a dramatic growth of successful and well operated radiant system applications within new and existing buildings. Stakeholders who will benefit from this, and will therefore support it, include building design engineers, architects, and builders, building owners and developers, building occupants, and utility and government representatives.

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)?

Currently, CEC/PIER is supporting a project entitled Space Conditioning in Near Zero-Net-Energy (ZNE) Buildings at CBE, which is focusing on radiant slab cooling systems. This project includes two field studies, one of which has produced the following example of a common problem facing nearly all new radiant slab system installations. After the system is designed, building operators are often left to use their previous experience (with all-air systems) to try to control the building. In the figure below showing trend data for a south zone on a cold, but clear and sunny day in December, one can see that the significant amount of cooling being supplied through the hydronic tubing in the radiant slab occurs right in the middle of each day during peak demand periods. The zone in the figure is being operated as if it is a quick-response air system. Thermally massive radiant slab systems have the advantage to be pre-cooled to avoid the type of operation depicted below.



CEC/PIER has also previously supported other research on radiant systems at both CBE at UC Berkeley and at WCEC at UC Davis, although these efforts focused mostly on case studies.

- 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.

Radiant heating has enjoyed widespread application and success in colder climates, such as Europe and Korea. However, in the U.S., where warmer and sometimes humid climate conditions are much more dominant, radiant cooling has been slow to be adopted, in large part because of the fear for risk of condensation on active chilled surfaces. In recent years, leading designers have begun to design more radiant systems in cooling climates, some of which have proven to be successful. An example is the David Brower Center in Berkeley, CA.

- 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.).

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.
- Quantifiable performance improvements for the proposed technology/strategy.
    - Successful radiant system projects should expect to realize 10-50% energy savings compared to a comparable building using conventional HVAC design and operation.
- Maximum market potential, if successful.
- Number of direct jobs created in California.
- Why this research is appropriate for public funding.
    - It will directly benefit the public sector

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

☒ Promote greater reliability

☒ Potential energy and cost savings

☐ Increased safety

☐ Societal benefits

☒ Environmental benefits – specify: provides opportunity for use of renewable energy sources

☐ 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

As mentioned above, the overall goal of the initiative is to develop comprehensive guidelines for the design and operation of successful radiant cooling and heating systems. This will include new and improved design tools (both simplified tools and whole-building energy simulation programs), as well as practical guidance and operating strategies.

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.