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Keeping California cool: Recent cool community developments

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ABSTRACT

In 2006, California introduced the Global Warming Solutions Act (Assembly Bill 32), which requires the state to reduce greenhouse gas emissions to 1990 levels by 2020. "Cool community" strategies, including cool roofs, cool pavements, cool walls and urban vegetation, have been identified as voluntary measures with potential to reduce statewide emissions. In addition, cool community strategies provide co-benefits for residents of California, such as reduced utility bills, improved air quality and enhanced urban livability. To achieve these savings, Lawrence Berkeley National Laboratory (LBNL) has worked with state and local officials, non-profit organizations, school districts, utilities, and manufacturers for 4 years to advance the science and implementation of cool community strategies. This paper summarizes the accomplishments of this program, as well as recent developments in cool community policy in California and other national and international efforts. We also outline lessons learned from these efforts to characterize successful programs and policies to be replicated in the future.

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1. Introduction

In 2006, California introduced the Global Warming Solutions Act (Assembly Bill 32 2006), which requires California to reduce greenhouse gas emissions to 1990 levels by 2020 [1]. It is the most ambitious climate policy that has been passed at the state or federal level in the United States to date. As California policymakers seek innovative measures to achieve this reduction, they are evaluating both mandatory and voluntary solutions. "Cool community" strategies, including cool roofs, cool pavements, cool walls, and urban vegetation, have been identified as voluntary measures with potential to reduce statewide emissions. These cool community strategies also mitigate the urban heat island effect, or elevation in city temperatures relative to surrounding areas. Co-benefits of heat island mitigation include reduced utility bills, improved air quality and health, fortified climate resilience and enhanced urban livability for residents of California. To help achieve these savings, Lawrence Berkeley National Laboratory (LBNL) has worked with state and local officials, non-profit organizations, school districts, utilities, and manufacturers for 4 years to advance the science and implementation of cool community strategies. Several entities have successfully adopted these measures – school districts are rethinking their schoolyards and rooftops, cities are achieving climate action and adaptation with cool community measures, and the state of California is showing climate leadership by developing guidance to help cities adapt to changing conditions. All of these policy developments are shaping a cooler future for California.

This paper presents several recent programs and policies in California that address heat island mitigation measures. We also briefly describe efforts underway in other jurisdictions in North America and internationally to deploy cool community measures. Based on these examples in California and elsewhere, we conclude by offering observations on the characteristics that contribute to the success of these programs and that should therefore guide future cool community measures.

2. Recent developments: successful cool community programs and policies in California

2.1. School districts

There are close to 10,000 schools across California with annual energy expenses totaling US$700 million [2,3]. Schools would therefore stand to benefit from adoption of cool community measures to reduce their energy costs. In addition, schools are among the largest building and pavement owners in California cities, so they are heavily invested in measures that can be optimized to improve environmental performance.

School districts in California operate with a high degree of local autonomy; they receive guidance from the state but do not fall under the local jurisdictions of the cities in which they reside. The size, complexity and operations of school districts have made it

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Fig. 1. Gardena Elementary School in Gardena, CA. The schoolyard is almost entirely blacktop with lines painted on the surface to outline games or activities.
Source: Google Earth.

difficult for many districts to employ new technologies. However, two school districts in California, Los Angeles Unified School District (LAUSD) and Sacramento County Unified School District (SCUSD), reached out to LBNL for help in understanding the science and potential benefits of cool community measures, and are on track to adopt innovative and cool programs as a result.

2.1.1. Los Angeles Unified School District's cool schoolyards pilot

In 2012, LBNL began convening a group of school stakeholders to help identify the barriers and opportunities for the adoption of cool pavements at schools. Many California schoolyards are large areas of blacktop (asphalt concrete) with lines for various game and activities painted on them (Fig. 1). Many cool pavement options come in a variety of colors, so in addition to making schoolyards cooler, cool colored pavement strategies also can be used to beautify schools.

The stakeholder group includes more than 50 participants representing pavement manufacturers, the California Governor's Office of Planning and Research, the California Department of Education, local school districts, landscape architecture firms, and LBNL. From these early discussions and meetings, LBNL developed technical resources tailored for school districts, and pavement manufacturers began to develop cool products for this stakeholder group with specific performance and cost targets in mind.

LAUSD was the first school district to ask LBNL to help them implement a pilot program. LAUSD is the second largest school district in the United States, with more than 1000 school facilities [4]. Los Angeles is the largest city in California, located along the coast in the southern part of the state. The city experiences mild winters with dry, warm summers. LBNL worked closely with LAUSD to develop a cool schoolyard pilot project that would keep schoolyard conditions more comfortable, especially during the warmer months of the year. LAUSD intended for this project to encourage innovation of cool pavement products, develop a district design standard, and train staff on the application/construction of these new products.

LAUSD staff members Chad Fenwick, Advisor to Physical Education, and Roshini Das, Sustainability Specialist in the Facilities Services Division, spearheaded the pilot project. The district's goal was to find products that are available in a range of cool colors to brighten the schoolyard and could be applied by their in-house facilities staff. First, the team met with product manufacturers to learn about currently available products and to see which products met the district's goals. Next, the team reviewed the most promising products with the district's New Products Committee, which is comprised of maintenance, planning, operations, procurement, design, safety and sustainability staff. This was an important step to get buy-in and support from various departments within the district. The committee selected several candidate products to submit for approval to the district's Office of Environmental Health & Safety. To date, two products have been approved by the Office of Environmental Health & Safety as safe to use in the district, while a third was not approved. Since district regulations only permit design standards with a minimum of three product options, the goal is to construct three pilot projects.

During the summer of 2013, construction was completed on the first pilot with Quest Construction Product's StreetBond coating at Gardena Elementary School in Gardena, CA. The epoxy-acrylic coating is durable and colorful, and can be applied over existing blacktop surfaces at the time of resurfacing. Most schoolyards in California undergo routine resurfacing every 5–7 years on the blacktop schoolyards. Often a seal coat is applied to the surface to protect the asphalt pavement system. Conventional seal coats are asphalt-based and are therefore typically black in color, ranging in initial solar reflectance from 0.05 to 0.15. The cool schoolyard coatings protect the pavement system and provide a more reflective surface, with solar reflectance values between 0.31 and 0.44, which allows them to absorb less sunlight than conventional seal coats and should allow them to last longer. Fig. 2 illustrates LAUSD's first pilot cool schoolyard design (a), the pre-existing blacktop (b), the application of the cool coating by the district staff (c), and the completed project (d). Currently, the district is planning the second pilot project and LBNL is working with the district to identify the final product for the third pilot.

2.1.2. Progress for cool pavements at other California schools

In addition to the pilot project in LAUSD, other school districts in California are now changing their pavement practices. One of the other cool pavement manufacturing partners, Western Colloid, applied its cool seal coat at four schools in Palmdale Unified School District in southern California (Fig. 3a). Cool schoolyard policies were adopted as part of design guidance at West Contra Costa Unified School District in the northern part of the state (Fig. 3b).

2.1.3. Sacramento City Unified School District's cool roof analysis

Sacramento is the capital city of California, located in the northern portion of the state's central valley. Sacramento has a Mediterranean climate, with mild, wet winters and dry, hot summers. Many of SCUSD's facilities feature dark asphaltic roofing products that are now in need of repair. The initial response by the district was to undertake costly roof replacements. However, one of the staff members, Ron Rudi, from the Facilities Division at SCUSD contacted LBNL to learn more about cool roof coating options. Their preliminary research suggested that a coating would extend the life of the existing roof, but they also wanted to quantify the potential energy cost savings from converting their dark roofs to white roofs. The LBNL team collaborated with the SCUSD Facilities Division to conduct a high-level analysis of the cost and emissions savings for 85 schools with combined conditioned roof area of more than 450,000 m^2. The analysis used postal-code level energy savings estimates and emissions factors from Levinson and Akbari [5] to assess the potential benefits of applying white roof coatings, adjusting for (a) efficiency of HVAC equipment used in SCUSD facilities, and (b) current energy prices.

The analysis revealed that by installing white roof coatings on their schools, SCUSD could save more than US$670,000 annually, net of heating penalties attributable to lower solar absorption during the heating season. Table 1 highlights the estimated potential for total annual cost savings for SCUSD by postal code and conditioned roof area, as well as the potential for reductions in emissions from conserved energy in the district. The Facilities Division presented these findings to district management and received funding to move forward with white roof coatings on the school facilities. To date, they have applied white coatings to more than 70,000 m^2 of roof on 30 schools.