

CURRENTS

AN ENERGY NEWSLETTER FOR LOCAL GOVERNMENTS

A Primer on Solar Energy for Local Governments

NOV/DEC 2000

By Peter Asmus

Solar energy is the basis of life on Earth. From photosynthesis' conversion of sunlight directly into food for plants to our global weather systems that shape cultures, commerce and individual lifestyles, the sun works miracles everyday. Solar energy is also absolutely critical to sustaining our atmosphere, whose stability is in jeopardy today due to the widespread burning of fossil fuels to generate electricity.

The electricity supply shortage in California this summer only increased air pollution linked to global climate change and urban smog. Older, more polluting fossil fuel facilities, as well as diesel generators originally installed for rare emergencies, were turned on frequently during hot days, when air pollution is already at its worst. Diesel generators are

10 times more polluting than vintage fossil plants of the 1960s, which are, in turn, 10 times more polluting than today's state-of-the-art fossil generators.

Unlike fossil fuels, whose prices are expected to remain high for the next few years, solar fuel is abundant and free. As federal, state and local government officials scramble to come up with ways to respond to California's current power supply shortage, not enough attention is being focused

CONTINUED ON PAGE 3 ►



One of the best ways to cool our communities and achieve energy savings is to plant trees that provide shade for parking lots, street pavement and sidewalks. See story below for more strategies for "cool communities."

Cooling California Communities

By Dr. Lisa Gartland, Director,
Sacramento Cool Community Program

Due to prevailing construction practices, California is full of urban and suburban "heat islands." The culprits are a lack of vegetation and shade, and roofing and paving materials that trap solar energy. This article describes the heat island problem and poses some practical solutions for communities.

Construction practices are heating up the land. NASA did a special fly-over of the Sacramento metropolitan area at noon on June 29 1998. The thermal image of Laguna

Creek, located about 10 miles south of Sacramento, shows most of the area is undeveloped grassland at temperatures below 95°F. Development along Laguna Blvd. is strikingly hot in comparison: Four commercial office buildings have rooftops at over 140°F and two parking lots whose surfaces are 110°-140°F. Not only are roofs and pavements hot, but very few trees or vegetation shade these surfaces.

These hot surfaces are the norm for development throughout California and the United States. The vast majority of roofs reflect away no more than 25% of the sun's heat.

CONTINUED ON PAGE 2 ►

WHAT'S INSIDE

Solar Incentives Up
DSM Peak Load Down
Using PVs for Shade
San Diego Energy Prices
PVs on Public Buildings
CD for Urban Foresters

Solar Panels Shade Cal Expo

Photovoltaic technology has long been used to create clean, renewable power from the sun's energy. Both SMUD and BP Amoco have found innovative ways to use these solar panels to produce benefits beyond the generation of electricity.

Solar panels have made parking a lot cooler at Cal Expo. SMUD recently installed 20 sun-tracking photovoltaic arrays in the main parking lot, which now produce enough solar energy to power 180 homes. The renewable energy being fed into the local power grid is not the only benefit of the project, it also provides ample shade for 1,000 parked cars.

With asphalt temperatures reaching 140°F in summer months, ambient air temperatures in large paved areas create an uncomfortably hot atmosphere and poor air quality. Emissions from parked cars are a significant contributor to smog. Shading the scorching asphalt means cooler air temperatures, less dependency on energy-thirsty AC units, and reduced emission of hydrocarbons that occur when gasoline evaporates from leaky fuel tanks and worn hoses. And shaded cars are much more comfortable to drive.

The first panels installed at Cal Expo were the ones ultimately farthest from the gate, but that's where



everyone wanted to park. Thanks to successful PV Pioneer projects like the one at Cal Expo, SMUD has the largest utility-owned distributed photovoltaic energy system in the U.S.

BP Amoco, the world's largest manufacturer of solar panels, is now ready to take a huge leap into solar power generation as well. BP Amoco announced that it will retrofit its service stations with transparent PV canopies over the gas pump area. Within four years, BP Amoco hopes to have PV canopies at all of its 28,000 service stations worldwide.

Not only will the new transparent canopies generate renewable solar energy, they will also provide shade from UV rays while creating a well-lit and safe atmosphere without the use of daytime lighting. BP hopes the canopies will create a cooler, more comfortable and inviting environment to fill gas tanks, while reducing energy costs.

Cool California

▼ CONTINUED FROM FRONT PAGE ▼

Even roofs with more reflective metallic surfaces have low emissivities that trap heat. Most parking lots use black pavements that reflect less than 10% of the sun's heat when installed. Even after they fade to gray, they reflect no more than 30% of the sun's heat. Trees and vegetation are an afterthought in design and neglected in practice.

Roofing and paving cover most of our urban and suburban land, and trees shade only small portions. A study of Sacramento's land cover found rooftops cover 20% and pavements 44% of the land surface. Sacramento's famous trees shade only 13% of the total metropolitan area. Levels of coverage vary from neighborhood to neighborhood. Rooftops cover from 12 to 28% of neighborhood areas, pavements cover 26% to 71% of neighborhood areas. Tree covers were as low as 2% and as high as 27%.

Hot surfaces and a lack of shade have many negative effects. First, hot materials wear out more quickly. Rooftops and paved surfaces heat up every day to peak temperatures as high as 190°F, then cool down overnight to the surrounding air temperature. This daily thermal cycling accelerates their failure.

Second, hot surfaces heat up the buildings below them. In the worst documented cases, over 60% of a building's cooling energy is needed just to overcome the heat transferred from the roof. Even in buildings with a considerable R-19 level of insulation, 20% of cooling use can be due to a hot rooftop. These extra cooling loads are not only increasing annual energy bills, they're also increasing peak demands on our electrical grid.

CONTINUED ON PAGE 4 ►

CD-ROM for Community Foresters

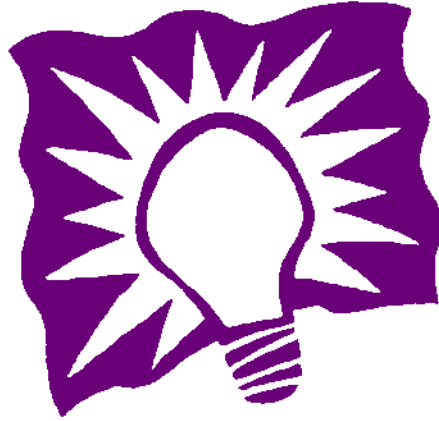
The California Department of Forestry and Fire Protection and the USDA Forest Service are offering "Restoring the Urban Forest Ecosystem," a new CD-ROM, to community representatives in California. The 10 illustrated chapters describe the principles and processes for restoring the health of urban forests. For a copy, e-mail eric_oldar@fire.ca.gov with your name, position within your community and a U.S. mailing address.

Local Governments Get A Solar Energy Lesson

▼ CONTINUED FROM FRONT PAGE ▼

on the role solar photovoltaics (PV) can play in reducing the demand for grid-connected power. An aggressive statewide program to install PV technologies before next summer would allow California to generate clean electricity when we most need it – when it is extremely hot and sunny – and thereby reduce reliance on the state's most polluting electricity generation sources.

Dan Shugar, executive vice president for PowerLight Corporation, a solar photovoltaics manufacturer, sees last summer's price spikes as a prime business opportunity. "We could install 1 MW of solar power on every Wal-Mart and large com-



mercial building in the state," said Shugar. The prices of PV are still high – in the broad range of 10 to 35 cents/kWh – but those same, and higher, prices were being paid for dirty coal power this past summer during supply emergencies.

Solar PV panels can be installed in a matter of days – not the three years it takes to site and build most large fossil fuel facilities. "Germany and Japan install roughly 70 MW of PV per year. We could do that right now and immediately start generating electricity," Shugar said.

Though his firm installed a 100-kilowatt system on the Anaheim Convention Center last August, that is just a tiny drop in the power supply bucket. Shugar maintains that California could generate 16,000 MW of electricity from the sun if every commercial and industrial roof was covered with his firm's PowerGuard PV tiles, an amount of clean power that represents a third of the state's entire demand for electricity.

DSM to Reduce Peak Load

With rolling blackouts in San Francisco and skyrocketing electricity prices in San Diego, there is a growing consensus for "demand-side management" to decrease energy consumption. DSM concentrates on encouraging energy efficiency and conservation measures to reduce the demand for electricity, especially important at peak times.

A new report from the American Council for an Energy Efficient Economy highlights four simple programs to reduce peak electricity needs of residential and commercial consumers:

- Tune up residential AC systems: By simply correcting installation and maintenance problems, we could reduce the summer peak demand by 14-25%.
- Tune up commercial buildings: Adjusting the air conditioning and electrical systems to more precise specifications could cut a building's energy use by 20%.
- More efficient AC systems: New energy efficient air conditioning systems use 20% less energy than new minimum performers.
- More efficient commercial lighting: By using more efficient lighting and automatic controls, the energy demand for commercial lighting could be cut 30-50%.

If fully implemented, the potential nationwide savings could reach 100,000 megawatts by 2010, representing more than 60% of the projected growth in demand over the next 10 years – equal to eliminating the need for 200 large power plants during the next decade.

For more information: Steve Nadel, ACEEE, (202) 429-8873.

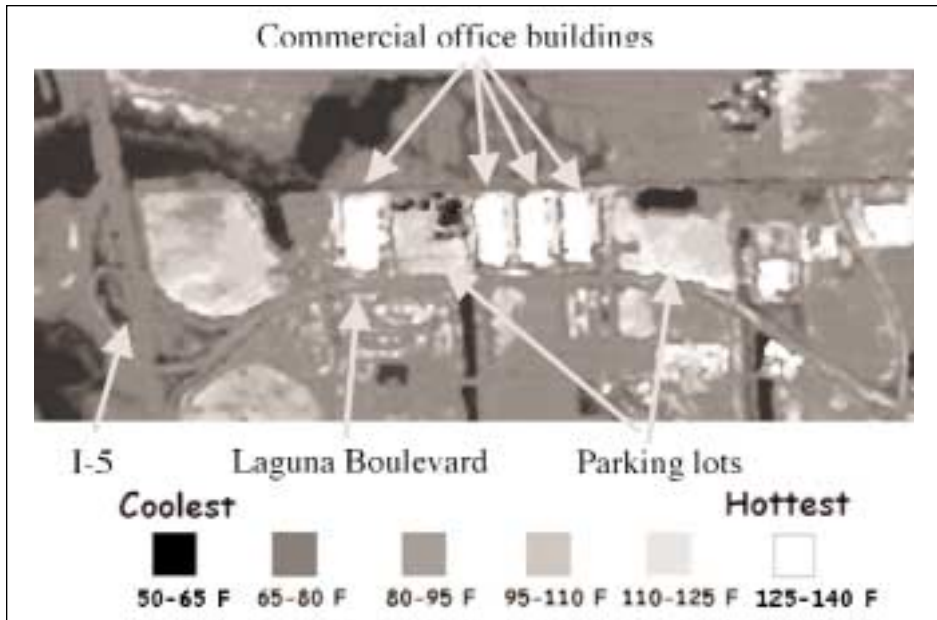
■ New Advances in Solar Cells

Always the most popular source of electricity among consumers, solar photovoltaic technologies have made huge advances in recent times. PowerGuard tiles, for example, are lightweight modules that not only generate clean electricity, but insulate buildings, which reduces heating and air-conditioning costs. These revolutionary concepts in architecture also extend the roof's life by protecting it from the weather's damaging effects.

One of the more intriguing recent PV breakthroughs was announced by Toshiba in September – the Graetzel cell, a new type of solar panel that consists primarily of titanium dioxide nanocrystals coated with a dye. "We do not need expensive production lines and sophisticated vacuum systems currently employed in the manufacture of silicon-based cells," said Shuzi Hayase, a chief research scientist

CONTINUED ON PAGE 6 ►

Strategies for Cooling California Communities



Heat islands: These Sacramento office buildings and parking lots are white-hot.

▼ CONTINUED FROM PAGE 6 ▼

Third, hot surfaces also heat the air above them. This creates local microclimates of hotter air, and larger “heat islands” that are 2 to 10°F hotter than the countryside surrounding them. These hotter temperatures are not just uncomfortable. They increase the energy and money spent for cooling, and in terms of human health they increase the risk of heat stress.

Fourth, the hotter the air, the faster smog forms. Smog forms when pollutants react chemically, and this reaction speeds up as temperatures rise. Air quality models of Los Angeles and Sacramento show that heat islands increase smog by 10% on hot summer days. More smog means more “non-attainment” days, and more asthma attacks and hospitalizations.

Finally, the lack of trees and vegetation in our communities is a lost opportunity for cooler temperatures, energy savings, improved air quality, and higher property values. An excellent series of papers by researchers at the USDA Forest Service’s Pacific Southwest

Research Station found that urban trees cool the air through evapotranspiration, reduce building heating and cooling use, filter pollution from the air, and even reduce car startup emissions.

There are three effective ways for communities to reduce their heat islands:

- Add trees and vegetation back to the landscape,
- Pave streets and parking lots with cooler alternatives,
- Roof buildings with cool products.

Sacramento has two innovative tree shading programs that can be emulated. The Sacramento Municipal Utility District (SMUD) and the Sacramento Tree Foundation collaborate on Sacramento Shade. This program sites free trees around the homes of SMUD customers to reduce cooling use. Sacramento also has an ordinance that calls for 50% shading of a parking lot after 15 years of tree growth.

Other ways to maximize the benefits of trees and vegetation include:

- Pass street tree ordinances to mandate minimum levels of tree planting,
- Review tree planting procedures to give them the best chance of survival,
- Review tree maintenance and removal policies and procedures to increase the retention of mature trees,
- Encourage the addition of trees or vines on trellises to cool older parking lots.

Asphalt and concrete are the most common pavement types. Asphalt usually has a lower first cost, but concrete typically lasts longer and needs less maintenance. Asphalt is naturally black or dark gray, and concrete is naturally light gray. Color makes a big difference in the amount of heat absorbed from the sun. Peak asphalt temperatures range between 130°F and 160°F, while concrete peaks at 100°-130°F. Asphalt pavements can be cooled by using white aggregates or rocks, adding light pigments to the asphalt, or finishing the pavement with coating in lighter tans, grays or terra cottas. None of these methods is in common use, although they show great promise to cool paving and increase its life.

Another cool alternative is to minimize the pavement used in urban design. Many communities are taking advantage of lower costs of narrower streets. Parking lots can also be smaller if they’re designed with attention to daily use patterns. And for a cool, stable surface, grass pavers can be used for occasional or overflow parking, or fire lanes around buildings.

The U.S. EPA’s Energy Star Roofing program signals great changes afoot in the

CONTINUED ON PAGE 7 ➤

San Diego Shows Solutions to Costly Energy Prices

Skyrocketing energy costs; businesses closing due to inflated energy prices; cities threatened with brownouts. These are just some of the realities San Diego has faced during the past few months as the result of deregulated energy sources. While the public's reaction demanded immediate solutions, the City of San Diego's Environmental Services Department (ESD) offers solutions to cutting energy expenses through its functioning Ridgehaven Green Building Demonstration Project.

"As the Environmental Services Department, we are tasked with designing proactive efforts that support a sustainable future for the environment," ESD Director Richard L. Hays said. "In the early 1990s, when our department changed names from Waste Management to Environmental Services and moved to another facility, the Mayor, City Council and ESD realized the need to live up to our new name and practice what we preach by creating an office building that would be the most environmentally sound and energy efficient building in the City of San Diego."

Today, that vision has evolved into the Ridgehaven Green Building Demonstration Project, which ESD occupies. Completed in 1996, the building's retrofit incorporates state-of-the-art lighting, water source heat pumps, recyclable construction materials and reused items that all contribute to the reduction of energy and water consumption and ultimately reduced utility prices. Also, the landscape around the building uses water conservation techniques, drought-tolerant plants, and recycled products to help reduce costs and energy use.

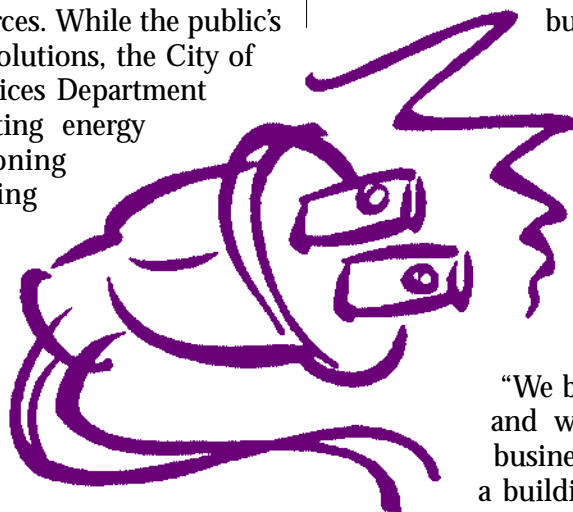
As a result, Ridgehaven is one of the lowest commercial energy users in San Diego County today and saves approximately \$90,000 annually in energy costs. This success has earned this energy-efficient building national recognition and in 1998 was the first building in the United States to receive the U.S. EPA and the U.S. Department of Energy's prestigious Energy Star Label.

"The Ridgehaven Green Building is truly demonstrating that designing an energy-efficient building is possible," said Hays. "We believe in the Green Building design and we will offer assistance to existing businesses and contractors to help retrofit a building that ultimately will save energy and money."

Past studies that determine saving also project future savings. During the next 10 years, Ridgehaven will prevent an estimated 3,540 tons of carbon dioxide, 10 tons of sulfur dioxide, and nine tons of nitrogen oxides from being released into the atmosphere. These greenhouse gases directly contribute to three major environmental problems: acid rain, smog, and global climate change.

"Energy is a resource and without it our lives would radically change," said Hays. "We are just the preachers of conservation, but it is up to everyone to embrace methods that reduce over use of our natural resources, whether it is simply turning off the lights or using an alternative fuel source."

For more information: San Diego Environmental Services Department, ☎(858) 492-5009.



Public Buildings Are Ideal for Photovoltaics

To help the state reduce peak load supply problems next summer, the Local Government Commission has been working with the U.S. Department of Energy, the California Resources Agency, the California Energy Commission, the California Department of General Services and the California Air Pollution Control Officers Association to develop

a program whereby local government, school and state buildings would house solar photovoltaic systems on their roofs and in their parking lots.

The U.S. Department of Energy conservatively estimates that city and county roofs could house 200MW of PV production, which would generate annual utility bill

savings for the local governments based on a \$5/kW price, including the state buy-down.

If you would like to be kept informed about this project or are interested in participating, call Pat Stoner at ☎(916) 448-1198 or e-mail to pstoner@lgc.org.

Solar Primer

▼ CONTINUED FROM PAGE 3 ▼

for Toshiba's Kawasaki power supply laboratory. "The new cells could be manufactured by silk-screen printing technologies." At present, at least seven companies in Japan, Europe and Australia are developing improved Graetzel cells that may end up gracing cell phones, laptops and even windows in energy-efficient homes.

Yet another exciting development in PV technology is so-called Building Integrated PV products manufactured by firms such as Atlantis Energy of Grass Valley, California. These PV products include roofing tiles that incorporate the PV materials directly into the original building materials. The firm also offers custom glass PV laminates, which turn windows into micro-power plants.

Integrating PV solar cells directly into building materials such as roofs and windows represent the ultimate solution to our power supply challenges since each and every new building could generate significant portions of its electricity on-site without the need for retrofit add-ons, thereby cutting costs and improving the aesthetics of new structures that will truly be green buildings.

■ A Role For Local Governments

Regardless of the specific solar PV technology employed, local governments play a key role in fostering a conducive planning and siting environment for PV.

According to Tom Hoff of Napa-based Clean Power Research, "the benefits of distributed resources have typically been analyzed from the perspective of the resource owner and the electric utility. Distributed resources also provide benefits to local governments." For example, local governments can

State Increases Solar Incentives

State consumers currently served by one of the state's three investor-owned utilities can now benefit from new laws passed this year that can reduce the cost of solar PV and other distributed generation system.

An existing buy-down program managed by the California Energy Commission still represents the largest pot of money available to entice local governments and other consumers to purchase PV. Up to half of the cost of an installation can be obtained through the CEC's emerging renewable buy-down program. So far, 395 PV systems have been purchased relying upon these funds. Consumer interest has increased dramatically since this past summer, so local government officials should move sooner rather than later if considering such a purchase. Since recent legislation has excluded local governments from receiving state rebates for grid-connected green power purchases, the CEC buy-down program looks even more attractive.

New legislation that provides a boost to solar power includes SB 1345, which provides grants of up to \$750 for PV systems backed up by batteries. This is an important measure because battery-backed PV systems are ineligible for the CEC buy-down grants, yet over half of PV systems installed in California rely on battery back-ups.

AB 918, which was also signed into law, standardizes the rate utilities will pay for solar generated electricity on residential rooftops that sell excess electricity into the grid. Under the new law, utilities are required to develop uniform methods for calculating the credits customers receive for generating this clean power.

guide future economic development by encouraging PV. While some traditional industries are very sensitive to power costs, many of the new telecommunications, Internet and banking industries are far more concerned about reliability. A combination of a solar PV array and a battery storage system can offer the kinds of premium-grade electricity these companies need for their sensitive high-tech manufacturing processes and computer information management systems, claims Hoff.

One of Hoff's more intriguing suggestions is that local governments install PV arrays in orientations that might not be the ideal for an individual customer. For example, he looked at electricity prices in San Diego this summer and corre-

lated these prices with south-facing PV systems and west-facing PV systems. A PV system that faces south will both produce more electricity and save more than a PV system that faces west. Nonetheless, PV systems that face west have a better match to peak than the south-facing PV systems. Hoff maintains that it may be better to give higher incentives for these west-facing PV systems or for local governments to install west-facing systems. Local governments would then be in the position of increasing power supply and thereby decreasing costs for all state consumers by reducing reliance upon grid power when it costs the most.

If bundled with aggressive energy efficiency

CONTINUED ON PAGE 7 ►



A Primer on Solar Energy for Local Governments

▼ CONTINUED FROM PAGE 6 ▼

measures, local governments can save money by reducing high-priced peak power purchases. PV systems are also excellent candidates for disaster relief support. Local governments could promote solar PV technologies for powering everything from medical equipment to traffic control devices to vaccine refrigerators. They could also encourage residents and com-

mercial consumers to install small distributed PV systems as part of any regions' emergency preparedness and as insurance against electricity outages.

The City of Chicago has already demonstrated what a municipal government can do when it comes to promoting solar PV. In response to a terrible heat wave in the summer of 1999

that killed over 100 people because of power outages, Mayor Daley announced in November 1999 that his municipal government would make major PV purchases. This commitment was made to attract Spire Corporation to locate its 100 PV manufacturing jobs in Chicago.

The first PV purchase placed a 10 kW array on a public school in December 1999. Then on Earth Day, commercial scale 50 kW PV arrays were placed on the rooftops of all ten major museums located in Chicago. In early June 2000, Chicago committed to building the world's largest solar PV array in the world. "The City is taking over a brownfield site – an abandoned privately owned landfill – and turning it into a 2.5 MW solar farm," said Steve Walter, assistant commissioner to Chicago's Department of Environment. The solar farm will fill 90 acres of land. Five more city schools were retrofitted with 10 kW arrays in August 2000.

Among the benefits of Chicago's aggressive solar PV program are a bolstering of local economic development, increased reliability of electricity supplies for its concerned constituents, and the delivery of environmental benefits to the surrounding community in the form of cleaner air and less waste.

"We are very seriously looking at the full range of distributed generation technologies to increase reliability within our city limits: micro gas turbines; fuel cells and wind turbines," said Walter. "This program would have never got off the ground without the (Mayor's) leadership," added Walter, underscoring the impact local elected officials can have in shaping community-based solutions to the problems of securing a clean and secure electricity supply.

Cooling California Communities

▼ CONTINUED FROM PAGE 4 ▼

roofing market. The Energy Star Roofing specification divides roofing materials into two categories, those intended for low-slope, essentially flat, roofs (mostly commercial and industrial buildings), and products for sloped roofs (mainly residences). Low-slope products must have solar reflectivities of 65% or higher initially, staying above 50% after three years. Sloped roof products must have initial solar reflectivities of 25% or more, staying above 15% after 3 years. The Energy Star Roofing specification does not yet include emissivity, so avoid uncool products with metallic finishes.

There are many Energy Star Roofing products for the low-slope market, mainly either roof coatings or single ply materials. These products are cost-competitive with traditional roofing materials, especially when factoring in long-term roof maintenance. They are all currently bright white, but some non-white products are under development. It's important to choose a product that's warranted for at least five years (preferably 10), and/or for a coating to meet standard ASTM D4083 for durability.

Conversely, there are very few Energy Star Roofing products for

the sloped roof market. Those that exist are expensive tile and metal products. Manufacturers have been slow to develop cool shingles in white and lighter colors, in the belief that there's little market for them. It's possible for shingles to have reflectivities of 40 to 50% - if only manufacturers would get serious about producing them.

California communities can promote the use of cool roofing in many ways:

- Inform the public – especially roofers, roofing consultants, builders and architects,
- Apply cool roofing to schools and municipal buildings,
- Write an ordinance to require cool roofing on low-slope roofs,
- Press manufacturers for more cool roof alternatives.

California state programs are being devised to promote cool roofing. Assembly Bill 970, passed this September in the wake of the summer's electricity crisis, designates \$50 million for energy conservation, including "incentives for cool communities." The California Energy Commission is currently considering rebates for the installation of qualified cool roofs. For the most up-to-date information, keep

CONTINUED ON PAGE 8 ➤

Strategies for Cooling California Communities

▼ CONTINUED FROM PAGE 7 ▼

an eye on www.energy.ca.gov/efficiency/ab970.

The agency is also updating the Title 24 energy code for non-residential buildings. This update will go into effect by 2002, and will include credit for using cool roofing. For the latest Title 24 information: www.energy.ca.gov/title24.

There are various cool community programs in California. The Sacramento Cool Community Program, one of three original pilot cities participating in the US EPA's Urban Heat Island Pilot Project, is housed in the Sacramento Tree Foundation. SCCP is working on the AB 970 cool roof program and a similar SMUD program, designing cooler parking lots, working with roofing

and paving manufacturers, and gathering information about heat island mitigation measures. Our web page is on the CEC site at www.energy.ca.gov/coolcommunity.

Los Angeles' cool community program specializes in the air quality improvement potential of heat island mitigation measures and has been active in tree planting efforts. For details: Gary Gero, ☎(213) 580-1024, ggero@ead.ci.la.ca.us.

There are three fledgling Cool Community programs in San Diego, San Jose and Santa Monica seeking participants and support. Contact Kurt Kammerer, San Diego Regional Energy Office, ☎(619) 595-5630, kkam@sdenergy.org; Rita Norton, San Jose's Environmental Services Department, ☎(408) 277-386, [\[ci.sj.ca.us\]\(http://ci.sj.ca.us\); or Susan Munves, Santa Monica's Energy & Green Building Program, ☎\(310\) 458-8229, \[susan-munves@ci.santa-monica.ca.us\]\(mailto:susan-munves@ci.santa-monica.ca.us\).](mailto:rita.norton@</p></div><div data-bbox=)

California is rapidly taking the leadership role in heat island mitigation, due in large part to key state government personnel. Commissioner Art Rosenfeld, our newest Energy Commissioner, is the father of the heat island research program at Lawrence Berkeley National Laboratory. Loretta Lynch, Director of the California Public Utilities Commission, has promoted legislative and budgetary items to support cool community programs.

You can call Dr. Gartland at ☎(510) 595-7674 or email lisa@pstvnrg.com.



LOCAL GOVERNMENT COMMISSION

1414 K St., Suite 250 ♦ Sacramento, CA 95814-3966
☎(916) 448-1198 ♦ fax (916) 448-8246

RETURN SERVICE REQUESTED



Check out the LGC's Energy Website:
www.lgc.org/energy

Toll-Free Energy Hotline: (800) 290-8202

Non-Profit
Organization
U.S. Postage
PAID
Sacramento, CA
Permit 1818

