Energy

Solutions for expanding renewable energy use and access, and helping local governments and businesses reach their renewable energy goals

Community Microgrids

Localized microgrids improve the energy independence and offer other benefits

Impact

Having relatively small, centralized microgrids that supply renewable, preferably carbon-free, electricity to one or more buildings or a particular area of a city decreases dependence on utilities and increases energy resiliency.

Description

Localized microgrids supported by renewable energy from various sources improve the energy independence of communities, reduce overall costs and reduce carbon emissions.

Where It's Been Implemented

A project map from Clean Energy Group (see References section below), shows the location of approximately 20 microgrid solar-plus-storage projects that have been completed in California. According to the map, as of late 2020, at least 15 more were underway, and still more were in the planning stages. Among microgrids installed in California are these three completed projects:

- Borrego Springs Microgrid in the Southern California desert town of Borrego Springs consists of a 700 kilowatt-hour (kWh) solar panel system and 700 kWh battery storage, enough to power 70 homes.
- Blue Lake Rancheria Community Microgrid, in Blue Lake, Calif., has a 500 kWh solar panel system and 900 kWh battery storage that are used to power community buildings.

- The Fire Stations Microgrid Project in Fremont, Calif., provides backup power and resiliency for three fire stations.

Peninsula Clean Energy (PCE), San Mateo County's public, locally controlled provider of renewable electricity, is currently working on a project to establish three to five locations that can serve as community emergency hubs. They will operate on microgrids equipped with solar and battery energy. Making facilities such as emergency hubs and government facilities energy independent is only the start. A long-term goal may be to make all communities energy independent.

Cities in the southern part of San Mateo County, using a state grant, developed a Peninsula Advanced Energy Community (PAEC) policy paper in 2019 that outlines strategies to integrate emergency microgrids, EV charging infrastructure, zero net energy buildings and solar energy storage.

New York has a grant program called NY Prize that helps communities in the state explore the feasibility of creating microgrids. It has funded feasibility studies in more than 80 locations throughout the state. The principal goal of NY Prize is to identify technical and business models for microgrids that can be replicated throughout the state. The prize competition is now in Stage 2. Eleven communities received funding to develop a comprehensive engineering, financial and commercial assessment associated with installing and operating a community microgrid at their proposed sites in New York State. As of August 2020, construction was expected to begin soon.

Description

Microgrids support community energy needs with better economics, reliability and resilience, while reducing carbon emissions. The U.S. Department of Energy describes a microgrid as "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode."

Julie Cart explains in CalMatters.org: "A microgrid can be as simple as a single home operating on its own solar power, or a complex series of connections between a power source and distribution lines to end users. It can run a business, a neighborhood or even a city. It can be any size and may be fueled by renewable energy stored in batteries, or by generators run on a conventional fuel such as diesel."

Key Drivers

In San Mateo County, Calif., Pacific Gas and Electric's (PG&E's) public safety power shutoffs are among the principal drivers for the timeliness of microgrid development. The utility's annual rates for electricity are increasing, and power reliability is declining. Due to safety errors during dangerous wildfire conditions, PG&E implemented a policy to shut off all power to the grid to prevent further disasters. Many people find this policy unacceptable, especially for buildings that need power such as government facilities, hospitals and important research institutes. While these facilities may have backup generators, community microgrids offer long-term solutions for energy resilience.

Key Factors for Success

Microgrids greatly increase energy resiliency in areas of the state that are prone to shutoffs due to wildfires or other causes. Properly integrated into the electrical system, they can act as distributed energy storage systems, reducing the need for more electricity generation plants, which often use natural gas or some other fossil fuel. Microgrids are particularly effective in those disadvantaged communities of color which are underserved by investor-owned utilities. In those communities there is an added benefit of cleaner air.

Key Obstacles

The PAEC policy paper referenced above found these obstacles to microgrids:

- The preference of building owners to make decisions based on (lowest) initial costs instead of life cycle costs
- Budgeting conflicts between capital costs and operating costs
- Split incentives between the building owner and tenants
- Limited financing options
- The question of who should fund and who should own advanced energy community components

Cost is one of the main obstacles for implementing new community microgrids throughout San Mateo County. The region is already electrified and connected to PG&E's larger grid, so a new microgrid may seem unnecessary. However, support for investment is likely to increase as dependence on PG&E becomes more difficult. A second equally difficult obstacle is the lack of widespread understanding of the definition, advantages and disadvantages of microgrids. PCE's project is expected to help resolve some of these problems.

Timeline to Implementation

Building an operational community microgrid is not a simple process. It begins with a feasibility assessment; then, system design, cost estimation and financial planning are needed to drive the project. After procurement of energy and materials and once construction is complete, utility interconnection takes place. Finally, the microgrid needs to be optimized through energy management..

Return on Investment

Each microgrid project is unique. Detailed financial calculations are necessary in the planning process. A detailed project plan and preliminary design are required in order to develop costs and feasibility studies.

Resources

Peninsula Clean Energy website, January 2020 Resiliency Strategy, Energy Resilience plans. Contact: Kirsten Andrews-Schwind, kandrews-schwind@peninsulacleanenergy.com, or Carlos Moreno, cmoreno@peninsulacleanenergy.com

Resilient Power Project Map by Clean Energy Group of projects that operate independently from the grid

"Building a Microgrid: Understanding Your Microgrid Life Cycle and Design," Microgrid Knowledge, July 25, 2019

Peninsula Advanced Energy Community. Contact: Diane Bailey, Executive Director, Menlo Spark, diane@menlospark.org

NY Prize for Microgrid Installation. Contact Michael Razanousky, 866-697-3732, X3245

"Microgrids 101," NY Prize

"Five Things to Know About Microgrids," CalMatters.org, November 1, 2019

Induction Cooktop Loaner Program

Loaning induction cooktops to individuals helps persuade them of the benefits of this alternative to gas cooktops.

The Impact

Converting to an induction cooktop is an easy change for individuals to make in their households to improve their home's energy efficiency and local air quality. Induction cooktops are electric ranges that use magnetic coils to heat a ceramic glass surface. Induction cooktops are safer to use than gas cooktops due to a lower fire risk and significant reduction to indoor air pollution. They heat up faster than conventional gas burners and are easier to clean.

Where It's Been Implemented

The Cities of Burlingame and San Carlos, Calif., have Induction Cooktop Loaner Programs. The City of Burlingame loans residents an induction cooktop and a compatible frying pan for up to two weeks at no charge. (As a result of the magnet-heating mechanism, induction cooktops only work with metal cookware.) The City of San Jose offers a similar program, allowing residents to check out an induction cooktop and cookware for up to two weeks. Acterra, a nonprofit based in Palo Alto, offers plant-based induction cooking classes along with its loaner program.

Sunnyvale's Environmental Services Department and Library provide a more extensive loaner program, offering residents kits that include an induction cooktop, frying pan, silicone spoon and slotted spatula and cookbook.

Description

Induction cooktop loaner programs allow residents to test out a cleaner, more efficient cooking method and convince many of them of the benefits. Typically, induction cooktops range in cost from $500 to $3,000. Loaner sets that include a portable induction cooktop, a compatible frying pan, a magnet and a cover cost around $260 dollars. (The magnet helps people determine if their cookware is compatible

with the cooktop.) Loaner programs can serve as an important opportunity for individuals to test the cooktop's efficiency prior to purchasing an induction cooktop.

Key Drivers

Induction cooktops are more energy efficient, safer and cleaner than conventional gas cooking systems. A Stanford-led study published in January 2022 revealed that the methane leaking from natural-gas burning stoves inside U.S. homes has a climate impact comparable to the carbon dioxide emissions from about 500,000 gasoline-powered cars. induction cooktops are also easier to clean. Since heating only occurs when the cookware is on the cooktop, induction cooktops significantly reduce the risk of fire and burns, which are more likely with open flame burners. Key Factors for Success

Induction cooktop loaner programs need to be supported by an organizing entity such as a library, individual or other sponsoring organization. When creating an induction cooktop loaner program, it is important to designate someone who is responsible for acquiring the induction cooktops, tracking who borrows them and cleaning them. It is also important to garner interest for the program through city newsletters and various social media platforms such as Nextdoor.

Key Obstacles

It is important to ensure that there is (1) a committed individual to sustain the program and (2) a liability waiver. Liability waivers should encompass possible safety hazards from handling the cooking equipment. A sample waiver from Acterra is attached in the References and Resources section.

Timeline to Implementation

To implement an induction cooktop loaner program, it's important to determine who is organizing the program (individual, library or organization). Then, the organizer should purchase the equipment and publicize the program. Organizers are encouraged to invite borrowers to fill out a survey following the use of the cooktop to gauge the effectiveness of the program.

References and Resources

Debbie Mytels, Co-Chair of Outreach Committee, Fossil Free Buildings for Silicon Valley, debbie.mytels@gmail.com, (650) 759-0888

Sample Waiver from Acterra

Ecology Center's Induction Cooktop Fact Sheet

Induction vs. Gas Cookoff Video by architectural firm Gould Evans

Burlingame Induction Cooktop Loaner Program

Acterra Plant-Based Induction Cooking Program

San Jose Induction Cooktop Check-Out Program

Energy Star 2021-2022 Induction Cooking Tops Info Page

Induction Technology Article from Forbes

Climate Impact of Gas Stoves Study from Stanford

Leaf Blower Regulation

Restrictions and bans on gas-powered leaf blowers reduce noise and air pollution.

The Impact

Many residents consider gas-powered leaf blowers to be a nuisance. Because these devices are noisy and cause air pollution, community activists have called for restrictions and in some cases, a ban on the use of gas-powered leaf blowers.

Where It's Been Implemented

In October 2021 California Governor Gavin Newsom signed a bill that will ban the sale of gasoline-powered leaf blowers, lawnmowers and chain saws. Under this law, the California Air Resources Board will decide how and when sales of these gas-powered devices will be prohibited. This prohibition could begin as early as 2024.

At the city level in California, Berkeley, Belvedere, Mill Valley, Sonoma, Los Gatos and Los Altos have banned the use of gas-powered blowers, and their use is restricted in Burlingame, Tiburon, Palo Alto and Orinda.

Description

California cities have restricted gas-powered leaf blowers in a variety of ways. For example, Los Angeles bans their use within 500 feet of residences. Davis has a ban on how long blowers can be used, limiting use to a maximum of 10 minutes. Newport and San Diego regulate the noise level, banning the use of blowers that are louder than vacuum cleaners at a distance of 20 paces. Burlingame limits their use in different areas of the city to specific days.

Key Drivers

Noise and air pollution are the main reasons some people want to regulate leaf blowers. They can be a serious problem for people with respiratory conditions, and individuals who work at home say they make it difficult to converse on the phone or participate in web meetings.

A study conducted in 2018 by acoustic engineers from a firm called Arup determined that gas-powered leaf blowers produced much more sound in the low-frequency range than electric blowers. Low-frequency sounds can travel farther distances than high-frequency sounds, making gas-powered leaf blowers a greater hazard to hearing health than battery-operated alternatives. The noise from a gas-powered blower can affect up to 15 times as many households as a battery-powered blower with the same 75-decibel rating.

Gas-powered leaf blowers use two-stroke engines that rely on fossil fuels. These engines function by mixing together gas and oil in a combustion chamber, ultimately releasing up to one-third of the mixture as unburned aerosol. In 2017, the California Air Resources Board warned that by 2020, gas-powered leaf blowers, lawn mowers and similar equipment in the state could produce more ozone pollution than all the cars in the state combined.

Key Factors for Success

Having a strong body of community activists and residents increases the likelihood of gas leaf blowers being restricted. It's also important to reach out to local gardeners' organizations and to present evidence that electric and battery-powered leaf blowers are available.

Once an ordinance is enacted, it's important for cities to remind residents about it.

Key Obstacles

The gas and oil industry has a vested interest in gas-powered leaf blowers, and many gas and oil companies lobby city councils that attempt to enact a ban. Once restrictions are enacted, residents must be aware of the rules and be committed to helping their neighbors understand them. Few police departments have enough officers to patrol for violations, so regulation is often dependent upon residents who file complaints about their neighbors. For that reason, some cities post flyers with leaf blower rules on their websites that residents can print out and anonymously slip on their neighbors' doorsteps.

References and Resources

Allen Meyer, Code Compliance Officer, Town of Los Altos, ameyer@losgatosca.gov, 408-399-5746

The Atlantic: Get off My Lawn

Los Gatos Leaf Blower Ordinance

Cupertino Leaf Blower Ordinance

Palo Alto Leaf Blower Ordinance

Burlingame's Leaf Blower rules, including reminder flyer

Low-Carbon Concrete

Using types of concrete that store CO2 can significantly decrease global carbon emissions and make buildings stronger

Photo courtesy of Zero Energy Project

The Impact

Concrete is one of the most widely used building materials on earth. Producing cement, one of the major components of concrete, by burning limestone accounts for 8 to 11 percent of global CO_2 emissions. Low-carbon concrete has an immense potential for cutting carbon emissions. For example, constructing LinkedIn's campus in Mountain View, Calif., with low-carbon CarbonCure concrete helped save 240,000 pounds of carbon from the atmosphere. In addition, buildings made from low-carbon concrete are structurally stronger than those made from traditional concrete.

Where It's Been Implemented

Low-carbon concrete has been used in numerous structures around the country and the world. Some of the first low-carbon concrete buildings in the Bay Area were LinkedIn's Middlefield campus, built in 2020, and a new academic building for the University of California's Hastings College of the Law, built in 2019. Boarding Area B in Terminal 2 of San Francisco International Airport was built in 2011 from concrete containing carbon-sequestered aggregate, which reduced carbon concrete emissions by 48 percent and helped earn the terminal "gold" status in Leadership in Energy and Environmental Design (LEED).

Buildings made from low-carbon concrete are structurally stronger than traditional concrete buildings. Marin County in California adopted the world's first building code that limited carbon emissions from concrete in January 2020. Since then, states like New York and New Jersey have approved policies mandating low-carbon concrete in construction.

Description

It's important to understand that low-carbon concrete is not one specific product. Rather, it's any type of concrete that decreases the amount of CO2 in the atmosphere when used in place of normal concrete. Concrete can reduce CO2 emissions in a number of ways, such as by trapping carbon dioxide through its solid structure or being composed of materials other than combusted limestone. The overall goal is to find a method of concrete production that releases less CO2 than usual or, better yet, traps more CO2 than it took to create the concrete, which is specifically known as carbon negative concrete.

Various companies have created their own solutions to this problem. Some of the most prominent companies in the low-carbon concrete market are CarbonCure Technologies, Blue Planet and Carbicrete. CarbonCure focuses on trapping the CO2 created in limestone combustion (a process known as sequestering) and injecting that same CO2 into the concrete, causing mineralization and embedding CO2 into the structure of the concrete. In addition to strengthening the concrete, this process also traps the CO2 in a form which prevents it from entering the environment.

Blue Planet, instead of focusing on the carbon footprint of cement production, tackles the overall issue by trapping CO2 produced by power plants, converting it to CO3 (carbonate), and using that to produce an aggregate that strengthens concrete. Carbicrete avoids creating CO2 emissions from limestone combustions by strengthening concrete with ground slag from steel production instead, and also decreases existing CO2 levels by curing concrete with CO2, embedding the gas into the concrete structure.

Key Drivers

Low-carbon concrete was produced to tackle the issue of climate change. One major source of greenhouse gas pollution is concrete production, as the limestone combustion process typically necessary to produce cement releases large amounts of carbon dioxide. In fact, since cement is such a high-demand material, the concrete industry is responsible for up to 11 percent of global CO2 emissions and, if it were a country, would be the third largest contributor of CO2 pollution in the world.. Low-carbon concrete aims to counter the unsustainable practices of concrete production by not only creating concrete through less pollutive means but also by removing CO2 from the air and trapping it within concrete. This process, when repeated by companies on a large scale, can create serious reductions in global CO2 pollution and possibly play a great role in the reversal of climate change.

Key Factors for Success

Marin County benefited from funding by the Bay Area Air Quality Management District's Climate Protection Grant Program and the cooperation of local government leaders, engineers and academics. Other partners included the Carbon Leadership Forum, the U.S. Green Building Council (USGBC) and leaders from the concrete industry. Many case studies contributed to confidence in the quality of the concrete. It's also important for local citizens and companies to be educated on the benefits of low-carbon concrete to increase support and minimize opposition toward low-carbon concrete mandates.

Key Obstacles

Very few drawbacks and obstacles exist for the implementation of low-carbon concrete. It is estimated that buildings made from low-carbon concrete cost 1 percent more to produce, which can be significantly more expensive for large structures. It also takes additional time and energy to cure concrete with CO2, and the energy used in curing needs to be renewable in order to not release substantial greenhouse gasses. Looking at the bigger picture, however, the advantages of low-carbon concrete far outweigh the disadvantages. Low-carbon concrete is structurally strengthened through the sequestering of CO2, it reduces the global carbon footprint and it promotes the usage of sustainable technology.

Timeline to Implementation

Marin County implemented its plan in January 2020. In general, the time to implement a plan such as this must include enough time to identify and consult with companies such as CarbonCure that provide the technologies and methodologies to decrease the carbon content of concrete, work with concrete manufacturers to create the desired product, and work with architects and engineers to best identify the structures and areas where low-carbon concrete can be implemented.

Return on Investment

Low-carbon concrete has been proven to be very effective in creating strong, durable structures. For around a 1 percent increase in price, consumers receive sustainable concrete strengthened with CO2, slag and/or other materials. There are no current reports of structures made from low-carbon concrete breaking down or facing stability issues. Low-carbon concrete structures have stayed sturdy and been recognized as sustainable, progressive buildings made with green technology. The reductions in CO2 emissions by the concrete industry from utilizing low-carbon concrete are also tremendous; CarbonCure, for example, reports that its technology sequestered more than 60 tons of CO2 during 2021.

Low-carbon concrete is a great option for companies and cities looking to meet their greenhouse gas reduction goals. Overall, there is a substantial return on investment for creating structures from low-carbon concrete in terms of prioritizing building strength and promoting sustainability.

References and Resources

American Society of Mechanical Engineers, Feb. 18, 2020. "Low-Carbon Concrete Can Fight Global Warming"

Bellona, Apr. 13, 2018. "Building with Low Carbon Cement is Affordable"

Building Green, Jan. 7, 2020. "Marin County First to Adopt Low-Carbon Concrete Code"

Carbon Cure, Jan. 19, 2021. "Central Concrete Meets Bay Area Demand for Low-Carbon Concrete"

Carbon Cure. "Reducing Carbon, One Truck at a Time"

Health Product Declaration Collaborative. "SFO: Poised to Become the World's Most Sustainable, Healthy Airport"

Zero Energy Project, Nov. 9, 2020. "Low-Carbon Concrete Starting from the Ground Up"

Reach Codes

These codes reduce fossil fuels in construction and offer health and safety benefits

The Impact

Reach codes reduce or eliminate fossil fuel use (primarily natural gas and propane) in buildings. They are usually mandated at the building permit stage, limiting gas heating, cooling, cooking and water heating equipment in new building construction. They can be made applicable to major remodels. Some reach codes also require electric vehicle (EV) charging infrastructure and photovoltaic (PV) panel and battery installation. A reach-code ordinance reducing and preventing the introduction of new natural gas installations will contribute greatly to a city's goal of lowering carbon emissions, making that city's response to the climate crisis stronger. Reach codes that require EV infrastructure will encourage more people to purchase more electric vehicles.

Description

Reach codes are building codes for new construction that "reach" beyond minimum state building construction energy code requirements to reduce or limit fossil fuels.

Where They've Been Implemented

In San Mateo County, Calif., as of June 2023, 17 cities, plus the County of San Mateo, and 13 cities in Santa Clara County, along with the County of Santa Clara, had approved codes that limit or partially ban the use of natural gas in new construction. According to the Sierra Club, 76 cities in California have adopted building codes to reduce their reliance on gas. The movement has spread nationally to about 24 other cities, and a few states, such as New York, have enacted gas bans. However, a backlash has prompted legislatures in more than 20 states to prohibit restrictions on gas bans in buildings. And Berkeley, Calif., is fighting a challenge to its ban that was struck down in 2023 by the U.S. Court of Appeals for the Ninth Circuit.

Background

Every three years, the California Energy Commission, working in conjunction with the California Building Standards Commission, adopts an updated version of the Building Energy Efficiency Standards – Title 24, Section 6 of California law. The latest code, which was adopted in 2022, became effective on January 1, 2023. Title 24 is applicable to new construction legally entitled after the effective date. Cities can opt to "reach" beyond the basic minimum requirements of Title 24, with reach codes that encourage or require electrification of all new construction. Cities may also adopt reach codes through their powers to regulate public health and through the adoption of other codes, such as changes to the National Electric Code (NEC) or their zoning ordinances

Key Drivers

All-electric buildings dramatically reduce carbon emissions, especially when they are coupled with renewable zero-carbon electricity sources such as solar and wind. In California, buildings are responsible for one-fourth of all state GHG emissions. All-electric buildings are cleaner, safer and less expensive to build. In addition, electric appliances are more cost-effective over time due to their energy efficiency, and they are healthier because they don't emit toxic fumes. Improved safety also comes from fewer residential fires and less chance of pipeline fires. On average in the United States, a natural gas or oil pipeline catches fire every four days, results in an injury every five days, explodes every 11 days and leads to a fatality every 26 days, according to Fractracker.org.

Key Factors for Success

Reach codes are generally implemented by elected officials, staff and the public who understand the impacts of natural gas on the health and safety of their constituents. Natural gas used in American homes is predominantly methane, a colorless, odorless gas extracted from the ground, often by fracking, which involves the high-pressure injection of sand, water and cancer-causing chemicals into the ground. A 2019 study gathered by researchers in six major U.S. cities found that the cities were leaking methane twice as much as previously thought. A 2022 Stanford study found that gas-burning stoves in U.S. homes have a climate impact comparable to the carbon dioxide emissions from about 500,000 gasoline-powered cars, and most of the emissions occur when the stoves are turned off. Methane is 80 times deadlier than carbon dioxide. Burning natural gas in home heating and cooking creates dangerous exhaust at levels that would be illegal if created outdoors.

In an effort to simplify the transition to all-electric homes, the City of Menlo Park, Calif., announced a partnership with BlocPower in June 2022 to electrify 10,000 homes and buildings by 2030. The program will focus on low-income neighborhoods and features a job training program that will create jobs while addressing the shortage of labor required to scale up the program.

Key Obstacles

There is often resistance to reach codes from elected officials, residential and commercial builders, the gas industry and members of the public who are unfamiliar with electrification. When elected officials are made aware of the deadly impacts of natural gas, there is a greater possibility they will adopt strong codes.

Builders are not eager to switch from their tried-and-true subcontractors and suppliers, and they believe renters and buyers will be less willing to rent or buy all-electric homes. Members of the public are often reluctant to give up appliances such as gas stoves and fireplaces. In addition, the upfront cost of electric appliances can be greater than their gas equivalents.

Yet electric appliances are cost-effective over time due to their energy efficiency, and many people who swear they will never have an electric stove change their minds when they try one of the

sleek new induction cooktops, which heat more quickly, turn off automatically when a pan is removed and can handle all types of cooking. As the public becomes supportive of all-electric homes, builders will follow suit.

Residential and commercial subcontractors for mechanical, electric and plumbing have skill sets in gas installation, but not so much in all-electric construction. Because subcontractors are not always knowledgeable about newer all-electric construction techniques, and because it is the subcontractor which assumes liability on construction projects, construction bids for all-electric construction can be unnecessarily higher than for gas installation. Some builders have found it useful to hire a consultant to work through this complicated process, with methodologies that are effective at resolving these problems.

Timeline for Implementation

Implementing reach codes is often time-consuming for staff and elected officials, due to the learning curve required. Meanwhile, government officials are responding to the threat of climate change by enacting stronger and stronger regulations. For example, California has a goal of reducing GHG emissions to 40 percent below 1990 levels by 2030, and the California Air Resources Board has banned the sale of natural gas-powered heating and hot water appliances starting in 2030. Over the next 25 years, there is expectation that natural gas will be phased out, as California reaches the "tipping point."

Return on Investment

All-electric buildings are much less expensive to construct if the work is done during the original construction.

References and Resources

The Campaign for Fossil Free Buildings in Silicon Valley

Sustainable San Mateo County. 2022 Indicators Report on Building Electrification in San Mateo County

Peninsula Clean Energy Model Ordinances, 2022

"Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California," University of California at Los Angeles, Department of Occupational and Environmental Health, April 2020

"Ten Truths About Natural Gas," Campaign for Fossil Free Buildings in Silicon Valley, 2019

"California Nears Tipping Point on All Electric Regulations for New Buildings," GreenTechMedia, July 29, 2020

Stanford News. Stanford Scientists Find the Climate and Health Impacts of Natural Gas Stoves Are Greater Than Previously Thought

Redwood Energy Construction Guides: All-Electric Multifamily Guidelines, All-Electric Commercial Guidelines, All-Electric Single-Family Construction Guidelines. These guides include examples of all-electric construction as well as information on appliances and electric equipment.

NRDC. Pipeline Incident Statistics Reveal Significant Dangers. January 2, 2019

"A $4.5 Million Grant from the State Sparks Menlo Park's Conversion to All-Electric Buildings." The Almanac, July 7, 2022

Rubberized Asphalt Concrete

Rubber from scrapped tires can be repurposed to resurface roads.

The Impact

Rubberized asphalt concrete roads present a sustainable solution to creating higher performance and more durable roads. They also divert discarded tires destined for landfills or illegal dumps.

Where It's Been Implemented

Rubberized asphalt concrete (RAC) roads have been used in California for three decades. By the end of 2010, 31 percent of all hot mix asphalt roads paved by Caltrans used rubberized hot mix asphalt. Asphalt rubber roads have been used by the Sacramento County Department of Transportation since 1990. In total, the Sacramento agency has recycled more than 1.5 million waste tires. Complete lists spanning hundreds of RAC projects over the last decades can be found on the Caltrans website under “Rubberized Asphalt Concrete.”

Description

Rubberized asphalt concrete (RAC) is made by mixing crumb rubber (ground-up, recycled tires from which contaminants such as dust and rock are removed) with asphalt. There are two primary binders associated with RAC: asphalt rubber (a blend of paving grade asphalt cement that has been successfully used for three decades in California) and terminal blend (a binder blended with finer crumb rubber that has been successfully used in California for two decades).

RAC binders are often applied at a reduced thickness compared with traditionally paved roads, which results in them being more cost effective. Moreover, RAC roads are more resistant to cracking, offer better sound dampening capabilities, retain their color for longer periods of time and can improve the traction of vehicles on the road.

As an added bonus, RAC roads can last up to 50 percent longer than traditionally paved roads and have added flexibility due to the rubber composite added to the mix.

Key Drivers

In California and around the world, wasteful practices often harm the natural world. Nearly one quarter of scrap tires end up in landfills. By 1994, in stockpiles alone, there were an estimated 700 to 800 million scrap tires in the U.S. Since then, removal and cleaning efforts have reduced that number to around 275 million tires in 2004.

A single 2-inch-thick RAC resurfacing project uses around 2,000 scrap tires per lane mile, and in recent years 10 million waste tires have been used in RAC paving projects around California.

Another factor to consider when considering the use of RAC is the durability and longevity of traditional asphalt roads. A conventionally paved road lasts an average of 10 to15 years and, when repaved, has a significant carbon impact, whereas RAC roads last about 50% longer. According to a study in the International Journal of Sustainable Transportation, better paved roads could save drivers 2 to 5 percent in fuel, tire wear, and repair and maintenance costs, thus lowering carbon impacts even more.

Key Factors for Success

In order for the RAC to have widespread success, cities or businesses need to be willing to implement this paving method in their community. Education on the benefits of implementing RAC projects and assistance with the technical aspects of construction will help those hoping to install RAC projects. In California, many resources are already provided by CalRecycle, such as grant opportunities and educational materials.

Key Obstacles

Given that the mix needs to settle in warmer climates, RAC installations run into some complications in areas of high altitude or areas with colder temperatures. The main obstacles to RAC's increased usage are lack of information regarding its benefits and insufficient funding. CalRecycle has sought to address both of these concerns by publishing guides for technical installation and education concerning RAC projects and providing financial aid through grants for those seeking out RAC technology.

References and Resources

Mustafe Botan, CalRecycle, Mustafe.Botan@calrecycle.org

Cal Recycle. A Basic Introduction to RAC Usage. March 2023

Research Gate. Caltrans use of scrap tires

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CalRecycle. Rubberized Asphalt Concrete Glossary

National Geographic, Sept. 20, 2019. "Tires: The Plastic Polluter You Never Thought About"

Environmental Protection Agency. Basic Information: Scrap Tires

Smart Glass for Commercial Buildings

Installing “dynamic glass" in large buildings saves energy

The Impact

Windows are often the most inefficient part of a building envelope. Installing smart glass (also called dynamic or electrochromic glass) or special sheet coatings greatly improves energy efficiency. It has the potential to cut heating ventilation and air-conditioning (HVAC) costs by up to 30 percent and lighting costs by as much as 60 percent.

Description

Smart glass products typically consist of layers of glass panes in a sealed, insulated glass unit (IGU) with a thin layer of metal oxides placed between two glass panes or applied to one or more panes. Bursts of voltage can stimulate color changes in the glass, causing it to change its tint. Another method is to physically and chemically treat the glass during manufacturing so that it automatically transitions during the day from clear to tinted, translucent or even opaque glass without electricity. For retrofits of existing windows, some manufacturers provide sheet coverings that are either electrically charged or treated with chemicals.

Smart glass can be incredibly useful for reducing the heat gain from sun-exposed windows. The glass can prevent the interior of the building from warming, thus reducing energy costs for cooling. As the day goes on, the tint of electrically charged glass can be programmed to automatically change to allow in more light and heat. This regimen can be optimized for energy efficiency. “Drawdown,” a comprehensive book of climate solutions, estimates that smart glass could result in 0.3 to 0.5 gigatons of emissions reductions between 2020 and 2050 in the U.S.

Where It’s Been Implemented

Smart glass is found most often in Europe and Canada. Examples are also found in the United States at Bowie State University in Maryland (shown above) and yogurt-maker Chobani’s office building in Twin Falls, Idaho. Other examples include the U.S. General Services Administration headquarters

building in Washington, D.C., the McKinnon Center at the University of New Mexico and the Luminary Office Building in Dallas, Texas.

Key Drivers

Greenhouse gas (GHG) emissions are one of the most pressing topics in climate change discussions because energy use contributes more than a quarter of all U.S. emissions. Therefore, solutions that significantly reduce electricity usage, especially in large buildings, can have a great and lasting impact on GHG emissions. Additionally, reducing energy use will drastically reduce long-term costs. While smart glass is more expensive than traditional glass, the energy cost savings can, over time, more than make up for the initial expense.

Key Factors for Success

Local climate, weather, building location and builder acceptance are all important factors for the success and impact of this solution. Buildings with high sun exposure will benefit much more from smart glass applications, both in new construction and in retrofits. During summer and warmer times of years, the energy requirement for cooling interior air can be reduced through the utilization of smart glass. Programmable smart glass can reduce heating loads in the winter, too.

Key Obstacles

The principal obstacle is price. While prices vary, smart glass is roughly three times more expensive than traditional glass. However, energy savings will accumulate over time, and smart glass has the potential to pay for itself in five to seven years. Additionally, heat waves and hot summers are becoming increasingly common, causing rising energy bills, so smart glass may become more cost competitive.

Timeline to Implementation

The best time to install smart or dynamic glass is at the time of new construction, although retrofit films do show promise. While additional care must be taken by the builder when installing smart glass, the time it takes to install it is similar to ordinary glass. Smart glass is not in wide use in the United States, but as knowledge of the benefits of smart glass increases, widespread use will likely accelerate.

Background

Historically, windows have consisted of only one pane of clear glass, which is a very poor insulator, quickly causing heat or cooling loss. In order to retain heat in the winter and keep heat out in the summer, double-paned and even triple-paned windows saw widespread use beginning in the 1970s. Today, single-pane windows are almost never installed in new construction or retrofits. In the early 2000s, improvements in production saw low emissivity or “Low-E” glass, a thin coating on the glass panes to keep heat in or out, depending on the season. Smart glass takes that technology one step further.

As awareness of the climate crisis increases, and as energy costs mount, there will be a push to install smart glass in new construction and take advantage of new technologies in window film retrofits.

References and Resources

Architect Magazine, October 11, 2019. “How to Specify Smart Glass”

Helpful Descriptive Brochures from SageGlass.com

Chobani Headquarters Example

Bowie State University Example

Streetlight Electric Vehicle Charging

Provide more public EV charging stations via LED streetlights that have excess electrical capacity

The Impact

Streetlight electric vehicle (EV) chargers increase the number of public charging options, encouraging wider EV adoption. They are especially important for residents of multi-unit dwellings who are less likely to buy an EV if they don't have access to home charging. Adding more chargers to multi-unit buildings or near them also improves social equity, as these buildings often house a fair number of people from marginalized communities. Moreover, increased community adoption of EV vehicles will have considerable effects on transportation-related greenhouse gas emissions, helping cities meet their climate impact goals. Clean vehicles also benefit community health by reducing the emission of harmful fumes.

Description

In recent years, many streetlights have been retrofitted to use LEDs. LED lights require much less energy to use and last longer than high-pressure sodium streetlights. With this conversion, most streetlights have an excess electrical capacity that can be used to power a Level 2 charger. Other forms of EV charging stations that are built in parking garages and on the curbsides require significant installation costs due to needed trenching and electrical upgrades. Retrofitting streetlights can greatly reduce or even avoid those costs by tapping into existing infrastructure.

These stations can be installed and operated by established companies such as GreenLots, ChargePoint, EVGo and Flo. Cities also can opt to purchase the chargers from these companies and have in-house engineers install them. Each company has its own app, which is used to unlock the chargers and pay hourly fees. The fee for streetlight chargers is usually $1 to $2 per hour, which includes the cost of parking. Users can easily charge their vehicles while they eat or shop, or even in some cases

they can charge them overnight. These charging stations are fitted with meters to allow cities to monitor and analyze usage.

Where It's Been Implemented

In Los Angeles, the Bureau of Street Lighting installed electric vehicle charging stations on 431 of the streetlights during 2020, after Mayor Eric Garcetti announced the Green New Deal objective in 2019 to have at least 100,000 EVs in the city by 2025. In the first 10 months of the program, more than 130 MWh of electricity were dispensed to EVs, with an environmental impact equivalent to reducing nearly 92 metric tons of greenhouse gas emissions or planting more than 1,500 trees. Most of the streetlight chargers were paid for with grants from the California Air Resources Board and the California Energy Commission.

Key Drivers

Lack of charging infrastructure is one of the major adoption barriers of EVs. Studies have shown that a robust network of public charging infrastructure, although not the only factor, is vital in promoting EV adoption. In California, the recommended EV-to-plug ratio, based on several studies, is between 7:1 and 27:1. As of late 2020, California had a ratio of 24:1, which is within the recommended ratio window, but more charging stations are needed to keep up with the growing demand for EVs.

It is important to note that EVs are not equally accessible to everyone. Lower-income families, which tend to lack off-street parking and the ability to charge at home, face a larger barrier to EV adoption. A 2018 survey showed that 81 percent of the EV owners in the lower-income range who live in multi-family dwellings rely exclusively on public chargers, compared to 16 percent of lower-range EV drivers who live in detached homes. California Assembly Bill 1796 grants tenants the right to install EV chargers at a multi-family dwelling at their own expense but doing so usually entails higher installation costs because of lower investment motivation and difficult tenant-owner negotiations. For EVs to be truly widespread, access issues need to be addressed.

Key Factors for Success

Streetlight charging stations work best in areas with high numbers of multi-family residential units but adding them to areas with smaller numbers of multi-family homes can have a big impact on EV adoption. In either case, usage will be boosted by adequate signage around streetlight chargers and extensive outreach, so that people are aware they exist. Non-EV drivers need to be convinced that adequate charging infrastructure exists around them before they will buy an EV. Clear signage at charging stations can alleviate "range anxiety."

Key Obstacles

If local streetlights are not owned by the city but instead are owned by the energy utility, it may be difficult to add chargers to them. To overcome this obstacle, local jurisdictions will need to either get permission from the utility company or buy the poles back.

Once installed, an obstacle that cities may face is non-EV vehicles parking in the spaces in front of the streetlight EV chargers. To avoid this, cities need to work with parking enforcement agencies to stripe off these areas to designate them as EV-only.

Another issue is accidental damage to EV chargers. In Los Angeles, some chargers are installed 10 to 15 feet above the ground to avoid vandalism, and the car connector slowly descends once someone unlocks it on their phone. However, due to impatience or misunderstanding, some people will yank on the connector, damaging it.

References and Resources

Los Angeles Bureau of Street Lighting Contacts

Disparities in Public Charging Infrastructure study

LAist.com. “L.A. Streetlights Might One Day Charge the Electric Car You Don’t Yet Have”

ScienceDirect. Public electric vehicle charger access disparities across race and income in California

Zero Percent Loan (On-Bill Financing)

Utility companies help finance the high up-front cost of homeowners' transition to cleaner energy

The Impact

Zero percent loan programs, also known as on-bill financing, increase the accessibility of transitioning to more energy-efficient infrastructure. Under a zero percent loan model, utilities cover the higher up-front cost of energy-related upgrades. Customers then repay the costs via an additional charge on their utility bill.

Where It's Been Implemented

Pacific Gas & Electric (PG&E) currently offers zero percent loans to commercial customers for upgrading to energy-efficient equipment. Loans range from $5,000 to $4 million for residents that have been customers for at least 24 months, of which 12 should be with good standing. Currently, the PG&E zero percent loan program is limited to energy-efficiency projects within PG&E's rebate program.

Southern California Edison has offered a zero percent loan program since 2010. Commercial and residential customers are eligible to participate. The program has provided over $10 million in loans, yielding a projected energy saving of 17 GWh and 2.8 MW.

Sonoma Clean Advanced Clean Energy offers zero percent financing for up to $10,000 for select energy technologies within Sonoma and Mendocino counties. Residential customers need to complete a screening application, select an energy upgrade and submit a participation agreement to join the program.

Description

With zero percent loans, utility companies incur the initial high cost of clean energy technologies. Customers then are required to repay the investment cost through an additional charge on their utility bill. A similar financing model, on-bill repayment, finances the program through a third party rather than the utility company itself. Since utility companies have access to a customer's energy usage patterns and payment history, they can assess the risk of adopting a zero percent loan program. Some zero percent loan models continue even after the initial homeowner moves, by including a clause designating the

transfer of the loan to the next owner of the property. Collectively, zero percent loans are an effective solution to both promote and increase the adoption of clean energy.

Key Drivers

Zero percent loans are an attractive solution to finance the high upfront cost of clean energy technologies. Under a zero percent loan program, customers can benefit from cleaner and often more efficient and less costly energy while repaying the loan that makes it possible. Utilities can maintain a secure revenue stream because they can disconnect customers from cleaner sources of energy upon a failure to pay. Overall, zero percent loans promote the market's transition to cleaner energy sources, making it easier for utilities and customers to benefit from clean energy.

Key Factors for Success

Having a committed utility and customer base to fund the initial up-front cost of a new energy technology is integral to a successful zero percent loan program. Private lenders may see a zero percent loan program as risky due to the heavy reliance on the customer base to repay loans. Utility companies may find adopting a new billing system and/or business model to be challenging. Thus, education and outreach programs can help in garnering more support and customers for the program, lowering the risk for private lenders and utility companies. Local governments can also support zero percent loan programs by creating policy or legislation incentives that would support such a program, collaborating with utility companies and backing zero percent loan programs.

Key Obstacles

Zero percent loan programs face two challenges: (1) adopting a new billing system and (2) reallocating remaining costs in the case of partially paid bills. Without a cooperative utility company, adopting a zero percent loan program can become difficult. Utility companies also face consumer lending laws and the need to readjust billing systems to an on-bill financing model. Zero percent loan programs must also account for resale of property, in which certain financing models may require businesses or homeowners to pay off the loan upon the sale.

Timeline to Implementation

To implement a zero percent loan program, a utility company must first survey the target region to determine the viability of such a project. Given a sizable population, the company must then design a zero percent loan framework. Then, the company can offer the program to the community and assess its effectiveness.

References and Resources

Bret Anderson, Carbon Free Palo Alto, bretande@gmail.com

U.S. Department of Energy On-Bill Financing and Repayment Programs

National Resources Defense Council: On-Bill Financing Overview and Key Considerations for Program Design

Southern California Edison: On-Bill Financing for Energy Efficiency Projects

Peninsula Clean Energy Zero Percent Financing

PG&E Energy Efficiency Financing

Carbon Free Palo Alto: BE Smart Program Overview (proposal for mass electrification proposal including on-bill financing)

Building Decarbonization Coalition Policy Report: Towards an Accessible Financing Solution

Other Solutions to Explore

Ban on New Fossil Fuel Infrastructure

In July 2021, Washington State's Whatcom County became the first county to enact a ban on new fossil fuel infrastructure. Located in the northwest region of the state near the U.S.-Canada border, Whatcom County suffers air and water pollution from the region's two oil refineries. The negative impact of the oil refineries on the region's fishing and orca populations led to the unanimous vote to ban any new refineries, coal-fired power plants and other fossil-fuel-related infrastructure. The ordinance also calls for any greenhouse gasses emitted by fossil fuel facilities to be offset.

The ordinance, the first in the nation, is a powerful example of how the U.S. can speed up the transition to cleaner energy sources. It was driven by the increasing awareness by county residents of the impacts of global warming, which negatively affected salmon runs, increased wildfires and caused unprecedented heat waves. The ordinance is here.

Home Electricity Assessment Toolkit

The Peninsula Library System and the San Mateo County Libraries in San Mateo County,Calif., offer a free Home Energy and Water Saving Toolkit to residents of the county with a valid library card. The toolkit provides residents with resources to lower their energy and water usage and provides them with the knowledge they need to make informed decisions about their energy and water use. The toolkit comes with easy-to-follow instructions in English, Spanish and Chinese. It includes energy- and water-saving items such as LED light bulbs to lower energy usage, a low-flow showerhead, outlet gaskets to prevent heat loss, and weatherstripping to seal the air gaps in windows and doors. Residents are permitted to use whatever tools they wish and return only those that they do not need. These tools can help lower utility bills, making living more sustainable and affordable.