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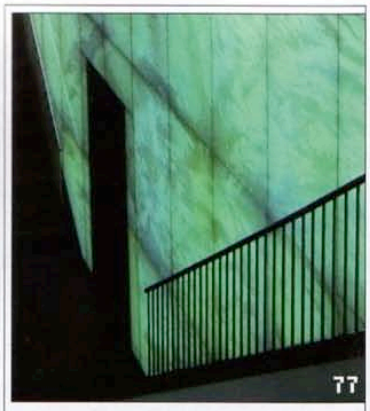

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Caruso St John's Brick House in London (cover and facing page) is an earthbound expression executed in concrete and brick. Images this page (left to right): a slum neighborhood overlooks urban "progress" in Mexico City; Ada Karmi-Melamede's synagogue in Israel; LEDs facilitate a changeable jewelry display.

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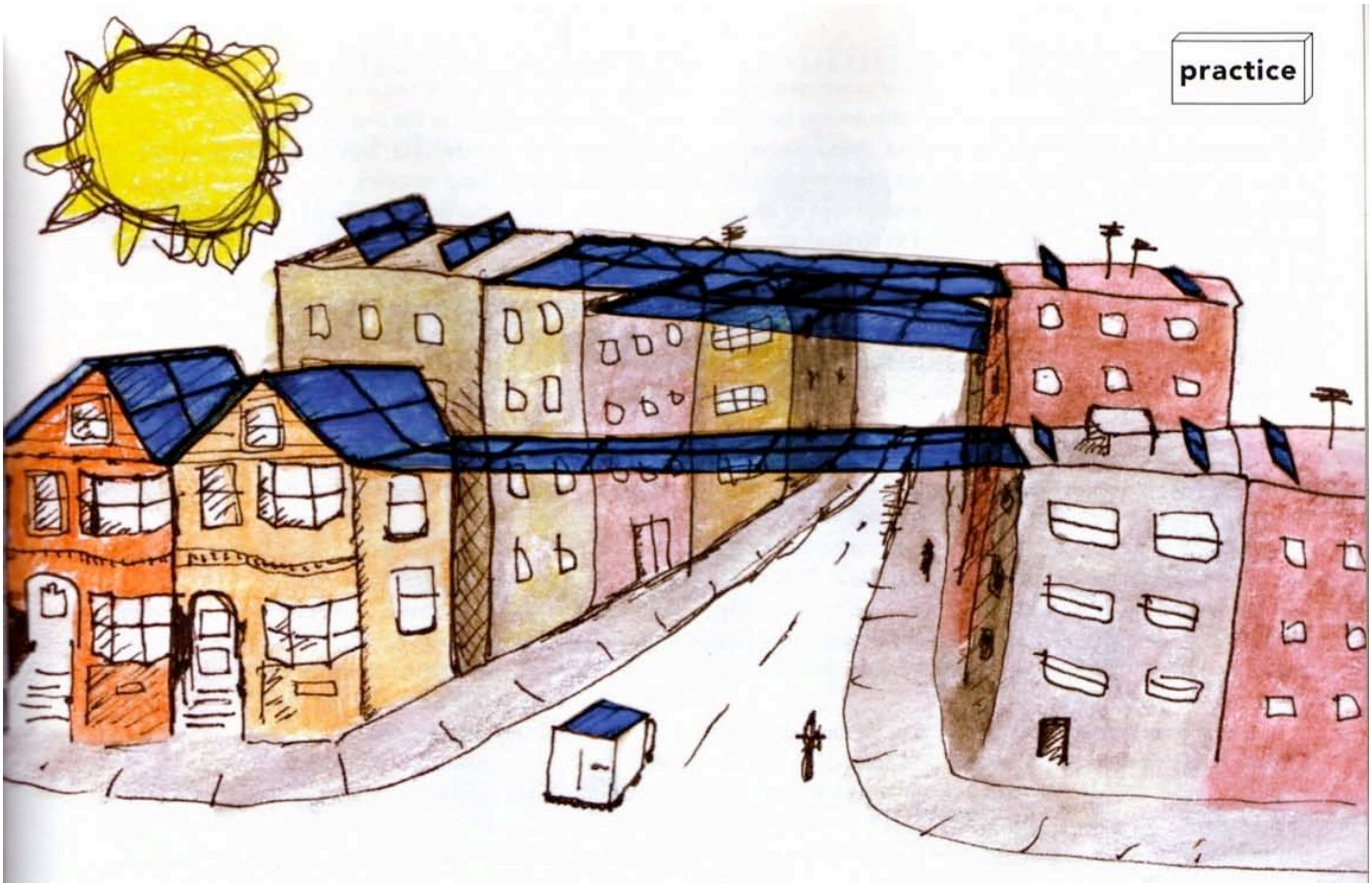
PHOTOGRAPHS ON COVER: HÉLÈNE BINET; FACING PAGE: IOANA MARINESCU; ABOVE LEFT: DANTE BUSQUETS/URBAN AGE; ABOVE MIDDLE: ARDON BAR-HAMA; ABOVE RIGHT: MICHAEL F. ROHDE.



SAN FRANCISCO'S 360

The Bay Area's natural resources—sun and water—will soon transform the utility and identity of the city.

by Paul Fenn and Michael Paulo Kuchkovsky | Illustration by Julian Osti

Over the next three years, San Francisco will invest over a billion dollars in a ubiquitous, decentralized solar power infrastructure placed on hundreds of public and private rooftops, fundamentally changing its urban environment and constituting the largest sustainable energy public works project in history. Following seven years of statutory and financial preparation, the new network will take 360 megawatts (MW) of physical electrical demand off the grid and onto a new solar hydrogen platform, in a community that consumes 650-850 MW on any given day. Within 12 years, if all goes as planned, over half of all power sold in San Francisco will be locally produced alternative energy, far exceeding the 20 percent "green power" generation required that year by California law.

The most dramatic result will be invisible but profound. Electricity production is the single largest cause of greenhouse gas emissions in the United States—and 25 percent of total emissions in San Francisco. Power plants produce two-thirds of the gases that cause our nation's asthma epidemic in urban children and two-thirds of all radioactive materials, not to mention the mercury contamination of virtually every river in the country. Not only is the production of power our core environmental threat, it is also the easiest to change. Weak government control of automobile manufacturing makes the other major cause of climate change (fossil fuels) inherently slower to transform: Re-powering buildings is the lowest-hanging fruit of climate protection.

For more than 30 years, visionary physicists and economists have posited a solar-hydrogen future. Following the change from burning trees to coal, and from coal to oil and natural gas (and the eradication of nuclear sources), scientists and economists have proposed a third transformation that would liberate our way of life from the vagaries of nineteenth- and twentieth-century behemoths. In the 1970s and 1980s, American environmental groups delivered a first wave of public subsidization of wind and solar power. But politics and money derailed this innovative vision, transforming the United States from technology leader to follower. Supported by federal subsidies under President Jimmy Carter, alternative energy industries that had emerged organically were subsequently dismantled by President Ronald Reagan. The government's disengagement from solar energy continued until California's energy crisis, the Iraq war, Peak Oil, and mounting evidence of an accelerated climate crisis brought sustainable power back to center stage in American politics.

The intensity of these crises has upped the ante of energy politics, leading many city governments to establish solar power initiatives on an unprecedented scale. In 1997 and 2002, respectively, Massachusetts and California passed laws

authorizing municipalities to take over power purchasing from utility corporations, and to develop sustainable energy facilities in the urban cores. Local Power, the Oakland, California-based author of Community Choice and related financing mechanisms, has assisted San Francisco in its development of a local solar-hydrogen economy that is expected to serve as a model for cities nationwide. Using Community Choice to select a new power provider and channel monthly electric bill revenues into a solar infrastructure rather than nuclear and fossil fuel plants, San Francisco will employ its voter-backed Bond Authority to finance construction of the new system. And the Bay Area is not alone: Currently more than 40 California cities plan to use Community Choice to develop solar technologies on an unprecedented scale. The traditional energy lobby is fighting Community Choice and solar power. If architects want to design buildings that incorporate large-scale sustainable technology, then they need to help seek a larger role in purchasing and developing green power. Community Choice is already law in Ohio, New Jersey, and Rhode Island, and legislation has been introduced in Washington, D.C., and other states such as Illinois and Maryland.

In Local Power's model, solar energy is reconceptualized as a classic public works project in which local governments issue municipal revenue bonds that allow capital investments to be paid back over decades—without increasing power prices. In this framework, the solar-hydrogen economy is not historically unique, but could perhaps become the most transformative infrastructure investment of the twenty-first century.

Combining renewable and fuel-free generation systems with power storage, heat recovery, cogeneration, and hybrid applications, San Francisco's 360 plan will fundamentally change the way its residents get their power. Phase One will result in the installation of 31 MW of photovoltaics throughout the city over three years. This is the equivalent of 200 to 300 supermarket-sized rooftops of solar panels. These facilities will daily provide enough energy to power 31,000 city apartments during the afternoon. Wind turbines, wave power, fuel cells, hydrogen, and other technologies will provide enough power for another 330,000 apartments. Wind turbines designed for dense urban areas could provide the energy production for this in-city component of the plan, as has already occurred in many parts of Europe. Hydrogen electrolysis facilities will be located near the major solar facilities that power them. Indeed, the urban environment will witness a new kind of gas station: hydrogen storage tanks and power generators that emit no smoke whatsoever, only steam. By 2009, San Francisco's new energy infrastructure will transform the urban environment in much the same way that the first municipal water and sewer systems assisted in developing the modern city.

Alternative energy installations follow natural patterns. Solar panels are positioned to maximize sun exposure and match the energy use of residents and businesses closest to them. The

selection of locations will depend on algorithms as complex as sites chosen for wireless service antennas. Sites will be identified, surveyed, and acquired based on optimal criteria. ("Acquired" may mean customers leasing solar technology, the city leasing private rooftops, and other such arrangements. Residents and businesses are able to choose how to participate in San Francisco's program, ranging from just buying the power, to hosting solar facilities on their rooftops, or even purchasing a local power facility with no-money down, long-term municipal financing.) Not merely investing in renewable resources, San Francisco will re-engineer power itself to reduce the need for centralized transmission systems, massive plants, and imported fuels, replacing the old megaliths with visible, quiet, and clean local power facilities.

Solar facilities on existing buildings will generate the majority of the 360 plan. Since it is typically more expensive and difficult to construct solar panels on existing buildings than new construction, architects will need to devise structurally sound, economical, and aesthetic systems for the program. Brooklyn, New York-based Kiss + Cathcart, for example, have already begun the process with projects such as the Stillwell Terminal (*Architecture*, January 2006, page 55). Designer Michael Jantzen, of MJ Architect, has pioneered a number of digital prototypes called M-vironments that integrate wind-powered generators into elegant open structures that also provide shade and shelter. Many groups, including the International Energy Association and European Cooperation in the Field of Scientific and Technical Research, have conducted and published extensive findings on solar technology and buildings.

Photovoltaic panels now come in a variety of materials, colors, sizes, and weights, with coatings that protect them from damage. Instead of stiff, thick panels, they are manufactured in flexible sheets that can be fashioned into almost any shape. With time, they will only get thinner, smaller, cheaper, and more efficient. Manufacturers are currently producing panels that not only generate energy, but also function as roofs, awnings, curtain walls, shading devices, and walkways. Apart from photovoltaics and the wind turbines and fuel cells previously mentioned, San Francisco's roll-out will include wave and tidal power systems, conservation systems such as heat recovery, wireless load control systems, and new power storage technologies such as flywheels and solar-electrolysis hydrogen.

Designing as part of the alternative energy production process clarifies the impact that architects have on the larger environment. Over the next decade, solar and other green power technologies will become as much fixtures of San Francisco as the Golden Gate Bridge or Coit Tower.

Paul Fenn is executive director of Local Power. Michael Paulo Kuchkovsky is architectural advisor to Local Power. This article was adapted from an essay previously published in *Architecture California*.