Architecture is in the midst of a renaissance. Never before have designers been so driven to consider the long-term effects of their building resources and practices. Never before have so many consumers demanded buildings designed to minimize environmental consequences. And never before have so many building standards, materials and techniques existed to support this burgeoning demand.

At the forefront of the movement are sustainable architects. It’s been no overnight success, though. Their decades of work in site-responsive, energy-efficient design have laid the groundwork for today’s green building movement. So what has driven these pioneers through years in which architecture has alternated between trends for environmentally responsive designs and those for commoditized, energy-hogging abstractions?

SOLAR TODAY asked five of these visionary designers to discuss just that, as well as their thoughts on where sustainable design is headed. A desire to create buildings that are integrated with the natural world is the driving force for partners Polly Cooper and Ken Haggard. For architects like Edward Mazria, a major driver is concern about the potential consequences of our fossil fuel-dependent lifestyle. For John S. Reynolds, it’s an appreciation for the sun’s ever-changing effects in light and shade, and the benefits of connecting a building’s inhabitants with these natural effects.

Mike Nicklas may capture this motivation best, however. To those who ask how his firm, Innovative Design, has integrated solar energy systems into some 4,800 buildings, he responds, “It was my priority.”
For some, it comes as a surprise to learn that partners having such passion for and influence on sustainable design began with quite different aspirations. Ken’s first degree is in chemical engineering, while Polly began in music history and education. Ken’s father, who spent his retirement ecologically rebuilding a burned-out peanut farm in South Texas, strongly influenced Ken. Polly was influenced by her frugal parents, whose memories of the Depression instilled in her an appreciation for conservation. She also appreciated the power of fans to provide comfort during Arkansas’ long, humid summers.

In any case, our search for a more integrated approach to the world led us both to architecture.

Shaped by the Times

The architecture of the early ’60s, dominated by a mechanistic approach to building and other disconnects from the natural environment, bothered us. Polly’s years at the University of California at Berkeley encouraged a tendency to question things. Despite much hero worship of the Modernists, nothing was sacred, including the dominant industrial architecture. Chris Alexander, Sim Van der Ryn and a thoughtful environmental control systems instructor helped her develop more appropriate criteria for design.

It wasn’t difficult to imagine how important these developments were. The 1972 Club of Rome Report on the finite nature of our resources was out, and the buildings around us clearly reflected our wasteful lifestyles. In addition, landscape architectural studies and Ken’s experience with environmental planning helped to broaden our perspectives on what could and should be done.

Now Shaping Design

In 1975, we met as professors at Cal Poly State University, beginning a long partnership. We spent many years at Cal Poly being a minority voice for a more sustainable approach to architectural education. In 1976, we established our architectural practice, specializing in site-responsive design.

The challenge of natural conditioning of buildings—taking advantage of on-site thermal sources and sinks and on-site energies—has always been fundamental to our work. In recent years, this emphasis has broadened to include a wide range of sustainable design. We have found that by combining our different perspectives, we achieve more comprehensive, integrated decisions.

Today our firm, San Luis Sustainability Group, consists of seven people. Among them is Scott Clark, one of our excellent ex-students, who does design and production interface. For thermal questions regarding passive solar implications and modeling, we consult with our long-time co-collaborator Phil Niles.

Over the years, our sustainable design projects have become known for several hallmarks: integration; miniaturization in design, to increase efficiency; consideration of externalities; and natural conditioning. Nearly 30 years since partnering, our goal remains unchanged: to help architecture become more connected to our organic planetary realities.

Polly Cooper and Ken Haggard are principal architects at San Luis Sustainability Group Architects, a Santa Margarita, Calif., firm specializing in sustainable planning and design. They are recipients of the American Solar Energy Society 1996 Passive Pioneer Award. Contact them at 805.438.4452 or slosg@slonet.org.
Polly Cooper and Ken Haggard’s firm, San Luis Sustainability Group Architects (SLOSG), began as a solar architecture firm and has evolved from passive solar prototypes to sustainable planning and design. During its 30-year history, natural conditioning via passive solar heating, passive cooling, natural lighting and natural ventilation has been a fundamental concern.

1972-1975: Prototype Roof Pond House
This solar house was built in 1972 as a prototype for the roof pond system of heating and cooling invented by Harold Hay. Several aspects distinguish the project:
- First documented 100 percent heated and cooled passive solar building.
- Only instrumented solar house in operation during the 1973 energy crisis.
- First comprehensive interdisciplinary evaluation of a passive solar building.
- First application of computer-aided simulation modeling of passive solar building performance, done by Phil Niles.

1976: Energy-Efficient Office Building
SLOSG’s design of an energy-efficient state office high-rise, with Christie Coffin, Phil Niles, Jake Feldman and Jens Pohl, was an Award of Merit winner in the California Energy-Efficient Office Building Competition. In addition to illustrating the application of the roof pond system to larger buildings, the design addressed urbanism and human-scale issues now referred to as “The New Urbanism.”

This handbook by Ken Haggard and Phil Niles, sponsored and published by the California Energy Commission, was designed to make it easier for architects in the state to design passive solar buildings. As part of this handbook, Niles designed the Cal Pas prediction model. This model became the basis of the performance standards in the then-new California Title 24 energy code.

Partially due to cuts in federal research funds and tax breaks, the 1980s saw solar architecture increasingly viewed as redundant and unfashionable. SLOSG survived by remaining small, with low overhead. During this period, the firm designed 160 solar buildings, mostly residences.

1991-1994: Green Materials and Social Aspects
In the early ‘90s, SLOSG expanded its design considerations to include green materials and the social aspects of building.

Noland House, Anchor Ranch, Lone Pine, Calif.
This project, in collaboration with eco-pioneer Pliny Fisk, combined passive heating and cooling with broad resource, health and metabolism issues for a move toward sustainability. The first permitted straw bale building in California, it featured composting toilets and processed wastewater with an interior microbial bed filter/marsh system.

Common House, Tierra Nueva CoHousing, Oceano, Calif.
This project, 27 units plus the Common House, illustrated that passive solar principles could be applied to a dense, socially cohesive situation.

1994: AIA and IUE Sustainable Communities Competition
This entry, a collaboration between SLOSG and faculty from Cal Poly State University, was one of the first-place winners in this international competition. It proposed processes for Los Osos, a community of 15,000, to evolve into a sustainable community:
- Regeneration of the watershed of Los Osos Valley.
- A structure for developing a sustainable economy.
- Diversity in transportation, housing types and community infrastructure.
- A community center consisting of civic facilities combined with a resource-recovery facility and open space.

SLOSG operates an off-grid, straw bale passive solar complex near Santa Margarita, Calif. During this period, the firm expanded into campus planning, education buildings for nonprofit groups, landscape regeneration and the politics of sustainability on the Central California coast.

2000 to Present: Passive Solar Public Buildings
Green design comes of age as its critical importance becomes increasingly obvious. SLOSG’s sample projects include the San Luis Obispo Botanical Garden Education Center, Congregation Beth David Synagogue and the Mountainbrook Community Church—all registered with the U.S. Green Building Council for LEED certification.
It’s time politicians and energy insiders leveled with Americans about U.S. energy policy. If we continue with our current policy of oil, natural gas and coal consumption, we will be keeping our troops in the Middle East for a long, long time and pushing the world toward a full-blown climate catastrophe.

More than any factor, it’s concern about these possible effects of our fossil fuel-dependent country that now shapes my work in architecture.

Why? Because U.S. oil and gas fields peaked in the ’70s and are in decline, and global oil reserves are now peaking with natural gas not far behind. We cannot expect to get more oil or gas from our neighbors, Mexico and Canada, because their fields have “plateaued.” Most of the remaining reserves are found in and around the Middle East. With U.S. and global energy demand increasing, not only will we be competing with other energy-starved nations for these remaining reserves, but our domestic coal use and greenhouse gas emissions will increase. The scientific consensus is that human activity, mainly burning fossil fuels, is rapidly changing our global climate with potentially catastrophic consequences.

Not to worry, we are told; if we cannot get our hands on Middle East oil and gas, we have Alaskan oil and natural gas, hundreds of years of recoverable coal (250 years by government estimates) and clean coal technology, plenty to meet our needs for the foreseeable future.

What we are not told:
- **Oil in Alaska’s Arctic National Wildlife Refuge** is only little more than one year’s worth of current U.S. annual oil consumption.
- **Alaska’s North Slope natural gas** is estimated at slightly more than a year’s supply.
- **If energy demand cannot be met** by imported natural gas or oil, then domestic coal use will increase dramatically. With a modest 2 percent to 3 percent rise in use each year, our recoverable coal reserves may last 72 years. Clean coal technology is decades away and costly.
- **The United States is projected to add 1,300 to 1,900 power plants** over the next 20 years. According to U.S. energy policy, “coal is expected to remain the dominant fuel in meeting increasing U.S. electricity demand through 2020.”
- **The United States is projected to add 22 million fossil-fuel burning mini-power plants** in buildings over the next 20 years. The new buildings we construct each year not only consume electricity produced at a central power plant, but also directly burn oil, natural gas and/or propane in boilers, furnaces and hot water heaters.
In a recent study published in the science journal Nature, 58 percent of the energy consumed in a building is burned at the site.

- **The building sector is poised to lead** the world’s rush to climate change. Transportation greenhouse gas emissions will stabilize in the near future due to the economics and scarcity of oil. Industrial emissions are not increasing much annually. That leaves buildings, and once built, buildings have a lifetime and energy consumption pattern that lasts for 50 to 100 years.

That leads to my second point: We are heading toward a climate catastrophe. Atmospheric greenhouse gas concentrations are at levels unseen in at least 450,000 years. Scientists worldwide agree that we must soon reduce greenhouse gas emissions by 70 percent in order to avert large-scale dislocations, destruction, and suffering. With world oil and gas reserves limited, coal is becoming the fossil fuel of choice. It’s cheap, dirty and abundant.

What we are also not told is that, if we continue burning fossil fuels, by 2050 we face dire consequences:

- **A quarter of all plant and animal species** on earth may be wiped out in the largest mass extinction since the dinosaurs, according to a recent study published in the science journal *Nature*.
- **A 2- to 3-foot rise in sea level is possible** as polar ice melts and seawater expands. At this level, the Environmental Protection Agency estimates that 10,000 square miles of U.S. coastal land will be lost, an area equal to the states of Massachusetts and Delaware combined. The Federal Emergency Management Agency estimates that 25 percent of all structures within 500 feet of a coastline will be lost.
- **Weather events will become more frequent** and extreme, causing loss of life and billions in property damage. The years 1995 to 2004 mark the busiest, most intense nine-year storm period on record in the United States, with 2004 shaping up to be the worst. Insurer Swiss Re estimates that climate-related claims could reach $40 billion in 10 years, and may bankrupt the global economy by 2065. By comparison, claims averaged $12 billion in the 1990s.
- **Abrupt climate change is possible.** Evidence demonstrates that Earth’s climate repeatedly has shifted dramatically and in spans as short as a decade. These shifts are linked to changes that make the North Atlantic waters less salty. Studies by the Woods Hole Oceanographic Institution indicate that over the past four decades, the North Atlantic has become dramatically less salty. The paradox is that if ocean circulation patterns are changed or suspended, a Little Ice Age in the Northern Hemisphere is possible.

Clearly, to end our dependence on Middle East resources and begin cleaning the atmosphere of excess greenhouse gases, we must quickly reduce our consumption of fossil fuels. A giant step in this direction is to *revolutionize* architecture by requiring all new structures to be carbon-neutral by 2025.

To reduce our consumption of fossil fuels, we must revolutionize architecture by requiring all new structures to be carbon-neutral by 2025.

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For three decades, I've been trying to get this sustainable design stuff right. My firm, Innovative Design, has designed over 800 buildings incorporating solar energy technology. Through a series of speculative solar home design initiatives, we produced solar designs that were built over 4,000 times throughout the Southeast. Our early designs concentrated on passive solar and space heating and energy efficiency, but by the 1980s, Innovative Design began to address more and more sustainable strategies in its building designs. Though our focus has moved from residential to school buildings, our current school designs tend to incorporate extensive daylighting, solar water heating, photovoltaics, rainwater harvesting, constructed wetlands, recycling systems, xeriscape planting strategies, low-emitting finishes and furnishings, a strong focus on indoor air quality, and many other green strategies. In a first for us, we're now designing a school that will incorporate a Living Machine—a biological wastewater treatment system that we've been working on for several years. East Clayton Elementary's east-west orientation and energy management controls improve the building's efficiency.

As Nicklas sees it, the only way to effect truly sustainable design is to let values lead.
Innovators

system developed by Taos, N.M.-based Living Machines Inc. that mimics nature’s own water-cleaning system. In this Greensboro, N.C., school, a rainwater catchment system will be used for toilet flushing. The waste will go from there to the Living Machine and once treated, to the ball fields for irrigation. From the fields, it flows into the aquifer.

We have designed 12 new sustainable schools, each better than the last. And we’ve completed renovations or additions on another 40 schools that have also implemented green strategies.

But during these 30 years, I’ve also seen a pattern of on-again, off-again enthusiasm for sustainable design. Such fads have little long-term effect. Worse, they may distract designers from efforts to develop the cost-effective techniques that will transform architecture as we know it.

**Targeting Points, or Benefits?**

During the past three years, I’ve worked with more than 30 other architectural firms in their own efforts to address an increasing owner-driven emphasis on “green” design. You need only look at the effects of the U.S. Green Building Council’s LEED (Leadership in Energy and Environmental Design) Green Building Rating System to detect designers’ growing interest in sustainable design. What’s driving this interest?

Years ago, the American Institute of Architects conducted a nationwide initiative to educate architects about how they could make their building designs more energy-efficient. At the time, the “Energy and Architecture” training program was viewed as extremely successful, with over a quarter of the nation’s architectural firms participating. Then, as today, the architects were responding to consumer demand. Several years after the Energy and Architecture effort concluded, however, the initiative was found to have had little impact on architectural design. Within a short period of time, the architects no longer implemented the energy-saving strategies that they had learned. I was part of that review committee that determined that the reason for this lack of long-term effects was primarily that the nuts and bolts of energy-efficiency were taught, but the moral reasons to do so were not.

The technical knowledge existed, but the architects simply didn’t care enough, from an environmental standpoint, to make energy-efficiency part of every one of their designs.

** Until the values of designers change, lasting effects will be hard to come by.**

Today we find ourselves in a similar situation, again driven more by consumer demand than designer values. I frequently work with other A&E firms, mostly conducting daylighting analysis; DOE II simulations; designs for rainwater catchment systems, constructed wetlands, PV and solar water-heating systems; and LEED compliance. With a wonderful few exceptions, my experience in working with these firms is that architects are more concerned about getting the LEED points than about the real environmental impact of their designs. Too many times, they have asked me if some specification is enough to earn the point—“I don’t need to do any more, right?” Too many times the concern is in earning the points most cheaply, rather than doing what will have the most environmental benefit for the least cost.

The shame is that the firms with which we have worked, for the most part, saw the various green strategies merely as a means to earning LEED points, not as parts that could be woven together into synergistic sustainable designs. This narrow perception greatly hurt their ability to most economically maximize environmental benefit.

**East Clayton Elementary School, built in 1997, uses extensive daylighting. Innovative Design was architect of the 96,800-square-foot school in Clayton, N.C.**

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**Mike Nicklas, FAIA**

Mike Nicklas, FAIA, is principal of architectural firm Innovative Design, Raleigh, N.C., and past chair of the American Solar Energy Society (ASES). Nicklas has held leadership roles in many leading solar energy and sustainable building associations, and was the recipient of ASES’ highest honor, the 1996 Charles Greeley Abbot Award. Contact him at 919.832.6303 or nicklas@innovative-design.net.

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**Breaking the Pattern**

The LEED initiative clearly has many benefits. Until the values of designers change, however, lasting effects will be hard to come by. Just as in the 1970s and early ’80s, we have a wonderful opportunity. Consumers are demanding greener and greener buildings. But if the sustainability of our planet does not become a “value” embraced by the majority of designers, we will find ourselves once again caught in a pattern. Where once architects aimed for designs that were “energy-efficient,” but not really, now everything is “green.”

People have often asked me how my firm could possibly get solar into 4,800 buildings when, in their minds, for 25 years solar has cost too much. The answer is simple: It was my priority.
Building for All Time

When I studied architecture in the 1950s, monumental buildings were considered exemplary: perfect as constructed, unchanging through a lifetime. As I subsequently practiced and especially as I taught architecture, the dynamic influence of the sun overcame such monumentality. The daily and seasonal cycles that the sun gives to earth, repeated over the years, present a far more interesting design challenge. People’s responses to these changes are even more challenging. Architects indeed give birth to their buildings, but the people occupying buildings then adjust them to suit the needs—of the day, of the season, of the era. A vital building must be responsive to cycles of time.

The sun is one of the most important of the attributes of any site, as it brings light all year, and the potential for on-site electricity production as well. (Indeed, I expect photovoltaic materials to replace the ubiquitous tar and gravel roof.) The sun brings friendly warmth in the winter and threatening heat in summer, emphasizing the seasonal change that I personally find so invigorating. The sun encourages designers to consider other on-site resources, such as the wind, which shares this seasonal shift from enemy to friend, but in reverse seasons to the sun. Rain, the timeless enemy of so many designers, can be captured to reduce a building’s drain on municipal water systems. Even the nighttime absence of sun can be cherished for its darkness, the stars a reminder of a universe of which we are but a small part.

The sun encourages a flexible building skin, but it imposes a building form constraint as well. Buildings elongated east-west are preferable, because their north- and south-facing windows respond easily to the sun’s seasonal change from enemy to friend. In contrast, east- and west-facing windows endure the daily glare of the low-altitude rising or setting sun, whether or not the sun’s warmth is friend or enemy at that time.

Designing for Daily Change

The sun’s apparent path through the sky represents one of our most enduring rituals, as momentarily imperceptible as it is inevitable. Sudden shifts of sky conditions add drama, with shadows of clouds moving across the landscape. This daily change is one of the most important reasons to design buildings for ample daylight. It keeps people in touch with the progression from dawn to dusk, and aware of the exterior environment upon whose health we all depend. The fact that daylight also displaces electricity is beneficial, but secondary. Daylighting fosters environmentalism.

Daylighting yields a dynamic interior environment, especially on days with alternating clouds and direct sun. Even in locations far from a window view, skylights and clerestories allow the presence of daylight and its shifting intensity that keeps us oriented in time and place.

Transition spaces between inside and outside offer some of the designer’s richest opportunities. Many times the outdoor environment offers temporary relief from the monotony of unchanging
indoor light, temperature and sound. At other times, it’s simply more comfortable outdoors. Porches and entryways are common transition examples.

In my experience, the richest transition spaces are the arcades around enclosed courtyards. The courtyard offers a piece of nature captured within the building site. As the sun shines into various arcades during the day, activities shift along with the shadows. Semi-outdoor spaces encourage migration, adding interest, even ritual, to a daily routine.

As the sun provides daylight and warmth, with the potential of glare, building occupants respond in ways difficult to predict. Movable sun controls are needed to moderate daylight and provide for direct sun, diffuse sun or shade. The sun encourages designers to provide a switch-rich exterior, replete with opportunities for personal control. Solar designers give users the opportunity for “thermal sailing.”

Aesthetically, a solar-responsive building presents a four-dimensional façade. Projecting lightshelves and sunshading devices bring the third dimension to otherwise flat facades, and the slow changes of their shadows over the façade or the rapid changes made by users add the fourth dimension of time. Thanks to the sun, architecture becomes a performing art.

Designing for Seasonal Change

Every solar-conscious designer knows the value of the overhang on a south façade: It can provide full shade all day long on the summer solstice, and full sun on the winter solstice. But the fixed overhang must also function in the spring and fall. It provides half sun, half shade on the equinoxes, like it or not. In many regions, the fall equinox is a very warm day when the direct sun’s heat is unwelcome. The spring equinox in such regions is a quite cold day, when sun is highly desirable.

Occupant-controlled sunshading is one good solution to this equinox dilemma. Deciduous vegetation is another. Vines can be given an open trellis shaped as desired for sun in spring, shade in fall. Vines are living awnings, changing color with the seasons, translucent at the equinoxes, opaque at summer solstice and a leafless pattern of twigs and trunk at winter solstice. It provides a vibrant organic overlay to the fixed geometry of the building façade.

Designing for the Long-Term

Difficult though it is, architects must look ahead to a time when their buildings will be demolished or radically changed. To avoid contributing tons to landfills, buildings can be designed to be recycled in whole components. This effort is a challenge especially for the thermally massive materials that are so useful for solar heating and night-ventilation passive cooling. One response is to use water containers for thermal mass. Another is to use precast rather than poured-in-place concrete.

Another challenge is to foresee societal changes, and design accordingly. Consider the multistory parking garage. If designed for parking forever, ramped floors save space. But such sloping floors inhibit a change of function—office, housing or retail—as the auto wanes. Better to place ramps at the building center, where after their removal the center may become a daylit atrium; and to design with more than the minimum floor-to-floor height, to accommodate daylight distribution and future mechanical and electrical infrastructure.

The sun has given me a respect for growth and change, and bid me welcome the users of my buildings as caretakers and partners in the buildings’ successful function.

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