of modernism outside the prevailing art historical canon.[4] Other recent scholarship along these lines has taken a more global, comparative approach, exploring how leading architects of the twentieth century brought regional approaches to climate adaptability into the design process.[5] Over the past decade, growing concerns about climate change and carbon emissions have led architects to consider the substantial levels of energy consumption and carbon emissions associated with the manufacture and transport of building materials. This relatively recent focus on embodied energy in new buildings has, in turn, inspired scholars to investigate the embodied energy of historic structures.[6] This roundtable builds on these directions in recent historiography to suggest the temporal arc and global scope of development in green buildings from the 1970s to the 2020s.

The essays are presented thematically, beginning with earlier projects in solar energy at different scales, followed by studies of specific housing experiments, alternative transformations of the building envelope in different contexts, and fundamental changes in architectural design practice, and ending with a comparison of contemporary approaches to shelter with minimal carbon emissions.

JOSEPH M. SIRY
Wesleyan University

Notes

1. See the programs of the SAH Climate Change and Architectural History Affiliate Group, which "explores the impact of the climate crisis on the methods and narratives used to write architectural history." SAH Climate Change and Architectural History Affiliate Group, https://sah.org/membership/sah-affiliate-groups/sah-climate-change-and-architectural-history-affiliate-group. This roundtable developed from the session "Green Buildings Since 1970: Collaboration for Energy Conservation" at the SAH 78th Annual International Conference, Atlanta, 2 May 2025. The session's contributors (Anna Renken, Shota Vashakmadze, Alissa De Wit-Paul, Andrew Tripp, Alexandra Staub, and Alice Paris) developed essays for this roundtable, as did five invited scholars who address its themes (Daniel A. Barber, Mary Ben Bonham, Barnabas Calder, Jiat-Hwee Chang, and Parinaz Mansourimajoumerd).

2. See, for example, Kiel Moe, *Integrated Design in Contemporary Architecture* (New York: Princeton Architectural Press, 2008); Brian Carter, ed., *Integrated Design: GSA/Morphosis/Arup; San Francisco Federal Building* (Buffalo: School of Architecture and Planning, University of Buffalo, the State University of New York, 2008); Susan Wels, *California Academy of Sciences: Architecture in Harmony with Nature* (San Francisco: Chronicle Books, 2008); Mary Thomas, *The Greenest Building: How the Bullitt Center Changes the Urban Landscape* (Portland, Ore.: Ecotone, 2016).

3. For example, see Dean Hawkes, *Energy Efficient Buildings: Architecture, Engineering, and Environment* (New York: W. W. Norton, 2002).

4. Jiat-Hwee Chang, *A Genealogy of Tropical Architecture: Colonial Networks, Nature and Technoscience* (New York: Routledge, 2016).

5. Daniel A. Barber, *Modern Architecture and Climate: Design Before Air Conditioning* (Princeton, N.J.: Princeton University Press, 2020).

6. Barnabas Calder, *Architecture from Prehistory to Climate Emergency* (London: Pelican, 2021); Barnabas Calder and G. A. Bremner, "Buildings and Energy: Architectural History in the Climate Emergency," *Journal of Architecture* 26, no. 2 (2021), 10–37; Barnabas Calder and Florian Urban, *Form Follows Fuel: Fourteen Buildings from Antiquity to the Oil Age* (Oxford: Routledge, 2025); Kiel Moe, *Unless: The Seagram Building Construction Ecology* (New York: Actar, 2020).

Becoming Active

Over the millennia, architecture has been concerned with the sun mostly in order to block it. Shading and the inertia of thermal mass were and are the primary means to reduce or mitigate excess heat. Strategies for utilizing the sun for radiant surfaces and stack effect ventilation are more rare and highly dependent on precise climatic conditions. Indeed, few Indigenous or regional traditions tried to or managed to heat through design means, without substantive fuel, and solar heating, unlike shading, was only a modern architectural phenomenon *in res potentia*; experimental projects were quickly overwhelmed by the flow of oil. The addition of heat to a building has most often been generated internally, and has again been starkly local—heated stones, charcoal braziers, ovens, eventually fireplaces, furnaces, to the monstrous HVAC systems of today. Much of our built world churns away with fossil fuels, as a medium for the processing of petroleum. The late twentieth century describes an arc from local and discretionary heat to an enclosure of a steady-state thermal surround of air. This is a very, very energy-intensive arc.

In the 1940s and 1950s, that potential operated through a vectored complexity of angles, insulation, and storage. In the projects of Maria Telkes, George Fred Keck, Arthur Brown, and many others, including the Space Heating with Solar Energy group at MIT, the building itself was a medium for solar optimization, in design, novel technique, and behavioral adaptation and training. George O. Löf's overlapped plate house built in the foothills of the Rocky Mountains outside Denver, Colorado, in 1957 deployed a simple ranch typology with overlapped heat-concentrating panels containing stacked carbon-black glass sheets.[1] The air warmed by these rooftop panels was stored in the house, in large floor-to-ceiling columns with thin concrete shells, filled with river pebbles—a latent storage system absorbing the heat and then releasing it as the air in the house cooled in the evening (Figure 1). Life with these columns involved seasonal and diurnal practices, adapting to the patterns of the sun. Solar architecture from this perspective, before photovoltaics, was both technological optimization and the elaboration of a solar lifestyle, a building design as instigation to an active engagement with its thermal properties. Thermal practices emerged—as ways of living in buildings, as primary considerations for designing buildings, and even as policy and regulatory elaborations of how to socially manage the built environment.

Löf's house was among the many experiments that 1970s practitioners drew on. Steve Baer, the designer of a house with a monumental water heat storage façade in the New Mexican desert, organized, in 1978, the reprinting of the proceedings of a 1961 United Nations Conference held

Figure 1 George O. Löf and James Hunter, Löf House, Denver, Colorado, 1957, columns filled with heat-storing river pebbles (photo by Anthony Denzer; used with permission).

in Rome titled "New Sources of Energy: Solar, Wind and Geothermal" (Figure 2).[2] In addition to those houses noted above, the book featured explorations by Aladar Olgyay, Raymond Bliss, Masanosuke Yanagimachi, and other architects and engineers, amid a wide range of discussions on the possibility of using alternative energy resources around the world.[3] Numerous design and heat storage strategies emerged as passive design technologies were placed next to solar water heaters, ovens, solar heat pumps for cooling systems, and a wide range of technologies, appliances, and devices.

What is especially striking about the distribution of knowledge of 1970s solar architectures to more recent generations is that they have been overwhelmed by technologies, metrics, and the sustainable imperative for efficiency. The emergence of sustainability and complex buildings with multipaneled glass façades and a delicate play of insulation, ventilation, and heat differentials produced a discourse that, much as the flow of oil overwhelmed alternative technologies, overwhelmed a robust discussion around passive behavior. A green building today—whether another airport, a sealed glass tower, or a thickly insulated Passivhaus—is generally conceived to be largely indistinguishable, in appearance, experience, thermal behavior, and even circulation, from an energy-intensive one, even though the system or its attributes might be novel. The system changes but the user need not.

Energy in architecture since the 1970s has been, again, awash in oil, as not only design methods and regulations but also material supply chains and consumer demand came to rely on an increasing flow of petroleum through the urban environment. Because the system changed so the user did not have to, it has become increasingly difficult to shape a consumer, client, or user eager to adapt, as possible, to seasonal and diurnal patterns of the sun as a means of thermal interior management and experience.

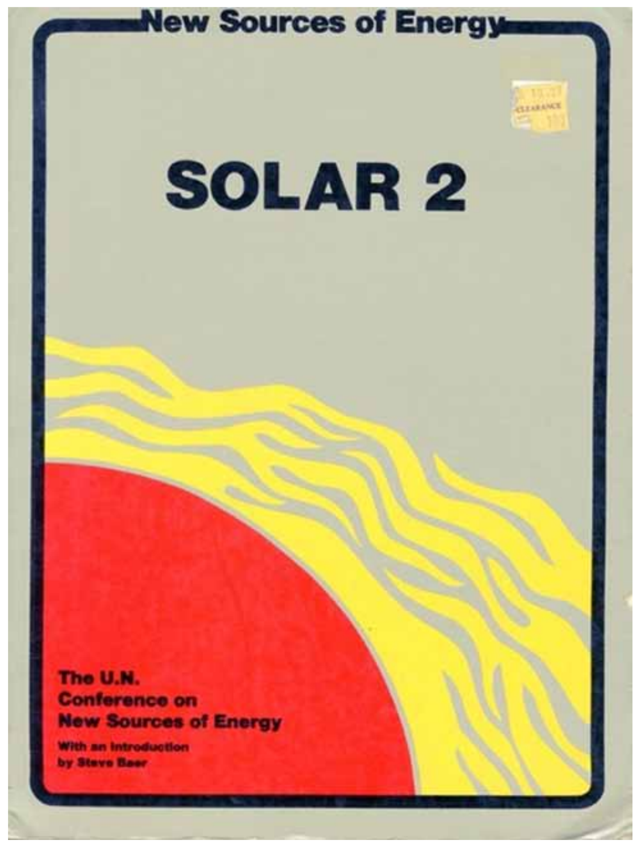

Figure 2 Front cover, *Solar 2: The U.N. Conference on New Sources of Energy* (Seattle: Cloudburst Press, 1978, originally published as *Proceedings of the United Nations Conference on New Sources of Energy: Solar Energy, Wind Power, and Geothermal Energy, Rome 21–31 August, 1961* [New York: United Nations Publications, 1964]).

On the other hand, practices have persisted that reimagine or resist those path dependencies. To trace a history of thermal practices, of becoming active, as both design methods and behavioral opportunities, from the 1950s to the present suggests two primary characteristics: (1) It is a history of concurrence, where explorations in using a building as a means to reduce energy throughput played out alongside a strongly dominant narrative of fossil fuel profligacy; (2) it is not only a history of building-scale interventions but also one of slow, sometimes imperceptible, shifts in behavior as part of a slow accumulation of tacit knowledge.

The history of becoming active is thus a quotidian history, reliant on the redefinition of practice: Whereas a habit might be felt as instinctual, a practice is considered, focused, aspirational. Practice involves ambition and, however subtly in some cases, transformation. It involves accumulation and aggregation—small efforts that add up. Designing for thermal practices can involve a building or a city, but it can also provide for an "adaptive opportunity"—a designed means by which using less energy is also more rewarding.[4]

At stake are both a new way of building and a new way of using buildings, of occupying space with a stark and overwhelming preoccupation with energy and its metabolisms. When to sit in which room? When to close down the office? When to put on a sweater? When to open or close the window? In exploring experiments in energy provision since the 1970s, can architectural designers recuperate a role as facilitator and cultivator, providing adaptive opportunities for building users—domestic and commercial, institutional and leisure—to consider new patterns and pathways? Not to render a building more aggressively performative, but to render an individual or community more willing to adapt.

DANIEL A. BARBER
Technical University of Eindhoven

Notes

1. See George O. Löf, "Performance of Solar Energy Collectors of Overlapped-Glass-Plate Type," in *Space Heating with Solar Energy: Proceedings of a Course-Symposium Held at MIT, August 21–26, 1950*, ed. Richard W. Hamilton (Cambridge, Mass.: MIT/Bemis Foundation, 1954); George O. Löf, "Solar House Heating," in *Proceedings of the World Symposium on Applied Solar Energy* (Menlo Park, Calif.: Stanford Research Institute, 1956). For a longer discussion of the work of Löf, Telkes, Keck, and others exploring solar energy in the 1940s and 1950s, see Daniel A. Barber, *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (New York: Oxford University Press, 2016).

2. See *Solar 2: The United Nations Conference on New Sources of Energy* (Seattle: Cloudburst Press, 1978). About a decade later, it is worth noting, Löf published an edited collection titled *Active Solar Systems* (Cambridge, Mass.: MIT Press, 1988).

3. Daniel A. Barber, "The World Solar Energy Project, c. 1954," *Grey Room*, no. 51 (Spring 2013), 64–93.

4. Wendy Hui Kyong Chun, "On Hypo-Real Models or Global Climate Change: A Challenge for the Humanities," *Critical Inquiry* 41, no. 3 (Spring 2015), 675–703.

SERI: The Solar Energy Research Institute, 1974–84

The Solar Energy Research Institute (SERI) was the predecessor of the National Renewable Energy Laboratory (NREL) in Golden, Colorado. Established in 1977, in an era of energy insecurity and technological optimism, SERI was envisioned as a transformative institution for researching, developing, and demonstrating renewable energy science. A permanent facility to match the institutional mission was designed in 1978–80, but the project exposed broader vulnerabilities, and the proposed megastructure was never realized.[1]

Authorized under the U.S. Energy Research and Development Administration and later absorbed into the newly created Department of Energy (DOE), SERI was conceived as the center of a nationwide renewable energy program. Planning for a permanent facility began in 1978, when SERI called for the design of a "living laboratory": an ambitious vision of a self-sufficient campus to accommodate and demonstrate renewable energy research by integrating experimental systems into the design, construction, and operation of the facility. Following a request for qualifications, SERI selected Table Mountain Architects and Engineers, a joint venture comprising Caudill Rowlett Scott Architects (CRS), Dubin-Bloome Associates, Rogers-Nagel-Langhart Architects and Engineers (RNL), and John Anderson Associates (JAA). CRS, based in Houston and three years from becoming the largest architecture, engineering, and construction firm in the world, was experienced in large, complex government projects. Dubin-Bloome, based in New York City and well known for its collaborations with Louis I. Kahn, brought an international reputation for integrating passive systems and mechanical engineering into the early stages of the design process.[2] The team impressed SERI with its expertise in energy conservation and solar energy systems.

This expertise was rooted in the existing relationship of architect Bill Caudill and engineer Fred Dubin, who shared long-standing interests in energy-oriented design objectives. Caudill had explored energy conservation as a promotional strategy in the mid-1970s, and by 1977 was actively searching for a demonstration project.[3]

The team drew from contemporary currents in structural concrete, modular expansion, and integrated mechanical systems to develop a preliminary design for the campus as a megastructure. The proposal comprised a series of buildings embedded in the contours of South Table Mountain