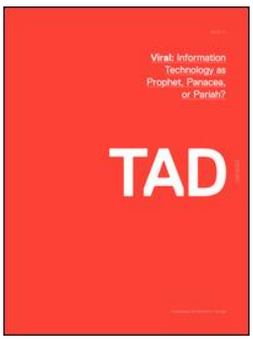

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Cities of Clarified Energy: Houston and Palo Alto

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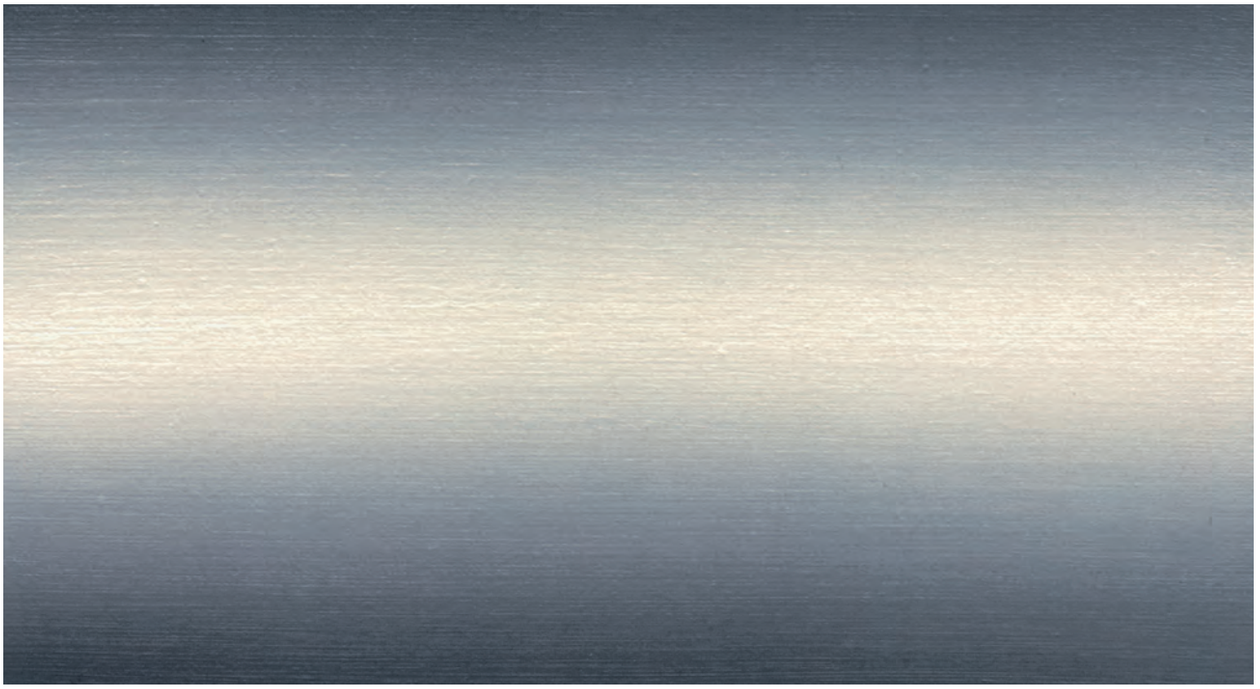
With double the energy of our first generation battery, Powerwall 2 can power an average two-bedroom home for a full day.

Introduced in October 2016, Powerwall 2 is a rechargeable lithium-ion battery designed to enable self-consumption of solar power, emergency backup, load shifting and other grid service applications.

Powerwall 2 consists of a 14 kWh lithium-ion battery pack, liquid thermal control system, an integrated inverter and software that intelligently dispatches electricity when it's needed most. The unit mounts seamlessly on a wall or on the ground, indoors or outdoors, and is integrated with the grid to export excess energy, maximizing the opportunity for economic benefit.

—Tesla Press Kit[1]



◁ Figure 1 (Previous page). A consumer-based energy awaits an architecture. Credit: Tesla press image.

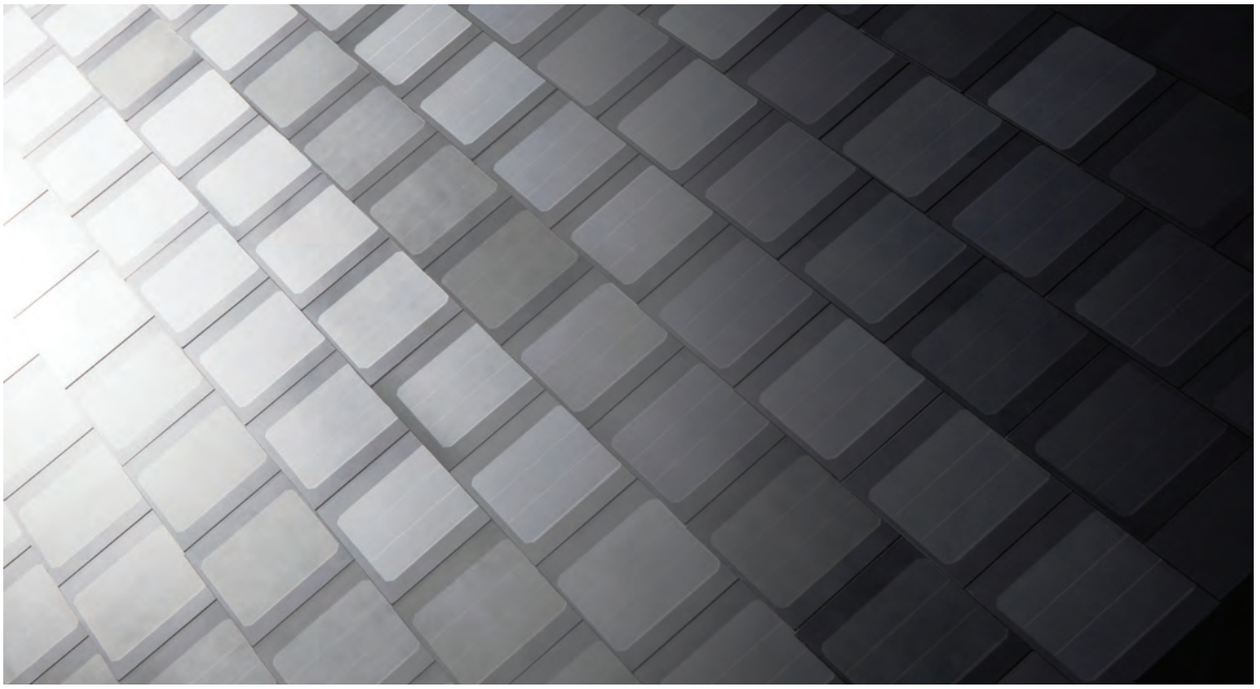
△ Figure 2. Sheet Metal, 1988, photo painting, Gerhard Richter. Source: Gerhard Richter Studio.

▷ Figure 3. Solar Roof, Optical Energy Arbitrage. Credit: Tesla press image.

"Anxiety and conflict have often been a sustenance of sustainability debates, yet as Silicon Valley enters the energy markets, with a networked triad of hardware and software managed automobiles, batteries and solar tiles are we about to deeply alter the psychological profile of sustainability and its subject?"

Tesla and Solar City launched the second installment of their home battery and integrated inverter known as Powerwall 2 in late 2016. The battery, a stationary storage device, forms a localized energy triad when coupled with the new Tesla Solar Roof and an electric Tesla automobile. A commodity-driven, consumer-based energy protocol. The Solar Roof is actually a new roofing shingle: a photovoltaic cell embedded on the back surface a glass tile.[2] While Tesla has not invented the photovoltaic tile, they have advanced it to a performance/aesthetic arbitrage. The tile conflates art and engineering and in a manner akin to a Gerhard Richter painting: the surface, substrate, and conductive materials are optically fused. Temporarily and chemically covalent and interdependent. The tile disguises the PV (at street level) removing it from sight. From the angle of the sun, the photovoltaic is revealed. The simultaneous optical properties are layered and organized in strata and together do the work to shed rain, harvest energy, and offer historical reference (the slate roof). Tesla fuses the aesthetic figure of a historic roof shingle with the light activated chemistry of a photovoltaic. While it is possible to forget that this is an energy product, the conflation of surface/material/depth reminds that humans see a very limited spectrum of light, and in this case, the different spectrums deliver diverse histories. The Solar Roof tile is a quasi-figural work that ultimately transfers the work of the eye toward the recognition of light and color as energy. It is a conflation of the visible and invisible light spectrums; its commodity role as a signifier of a historical roof shingle only half-disguises the optical work of energy. It instigates a desire to indeed imagine what we can't see.

Powerwall captures the energy for future (nighttime) use and ideally for use in your electric car. Net zero + beyond: while the diagram is relatively simple, it is the consumer-driven aspect of this that is radical. A disruptive product on one hand, but one that is completely market driven (and market affirming) on the other. Will Powerwall help alleviate energy demand, diminish atmospheric contaminants? Probably. Will it increase suburbanization (by lowering private energy costs) and exacerbate future demand for transit if it enables more distant development—a new last mile? Is it a bolt on addition to architecture that supplants the need for architecture to innovate and evolve? Regardless of the answers, it seems to find the most resonant effect in how it alters our frame of reference to the troubled



history of the fossil-fuel-based city and our decades-long concern about its future. A deep potential to alter energy profiles coupled with a market entry (a sleight of hand—that happens to be radical): Tesla proffers a potential for dramatic change in what are nonetheless understatements. If I can order Powerwall and plug it in with relative ease, why am I not doing this?

Powerwall appears to enable a de-ethical-ization of a problem that has vexed sprawling urban development for decades. Powerwall and the Solar Roof as architectural products become essentially urban and thereby social in their end effect.

As the architectural community assembles these components into buildings, into architecture, what do they achieve and disrupt in architectural thought and history/theory? Do we have theoretical outposts for the work their products portend?

Part One: Architecture in the Sprawling Twilight of the Fossil Fuel City

As a professor at the Rice University School of Architecture (RSA), in Houston, in the 1990s, it was often difficult to find a foundation for architectural design. Against the backdrop of an enclosing (foreclosing) horizon of the city's 60-mile-wide sprawl, RSA thrived as an architectural think tank and lab. Houston, as a contemporary *metropolis, evidenced every aspect of globalization* and both enthralled and humiliated architectural aspiration. The critical touchstone was a then close to contemporary Manfredo Tafuri, but so too were what then felt like arcane references to the geographic/urban consequences of the Bretton-Woods Treaties and a range of economic and political instruments essential to the formation of the postwar city. Houston, as daily lived experience, however, made the critical/historical theories immediate and new. The scholarship/design that emerged from RSA spanned a century of architectural thought on cities, economy, and political/social thought but also took into account the experience before us: weather, humidity, the weighty-slow bayous flowing though the city's clay (foundation-destroying) soils. In the face of a fragmented zoning-less real-estate-driven city, RSA offered a distilling: a witnessed and momentarily clarified city where form, history, and energy of all kinds was grasped as liquid, flowing and real.

Houston and Rice attracted a deep reserve of architectural talent from the East and West Coasts. That talent—inevitably—observed the pull of the city as an eclipsing presence, and rapidly the term urbanism came to be a common zone of inquiry most pointedly by way of Lars Lerup but also by Albert Pope and Sanford Kwinter. In this context, Sze Tsung Leong and I assembled a volume of writing and projects titled Slow Space,[3] attempting to capture the spirit and content that marked this shift. RSA faculty made a hard turn toward the wider city even as they sought to stay close to architecture. Urbanism—a quality of a city rather than its form placed "the urbanist" into the zone of their own inquiry. Architecture was seen as a kind of by-product of promiscuous capitalism.[4] Enunciating a fusion of architectural thought and urban space as money, markets, and economic policy: a designer, forced to swim in the very pool that threatened drowning. For an urban subject architecture was alternatively an instigator and lever ideally triggering a comprehension of the entire milieu. What was not as clear (or as actionable) as it is now was the transformation of the oil empire we were in the midst of, or more so its twilight. Houston was still the origin of an immense amount of the oil that flowed in (pipeline) tributaries northeast and northwest into the United States, yet it was also clear that the empire of fossil fuels was under duress. The existential nature of living in the aftermath of an empire compelled creativity; it felt as if history, theory, and more so architects themselves were being tested. Flow was everywhere: from oil to

△ Figure 4. Davos, 1981, Gerhard Richter. 50 cm x 70 cm, Catalogue Raisonné: 468-1, Oil on canvas. Richter's Photo Paintings translate photo-chemistry back into optical light as oil based painting. Source: Gerhard Richter Studio.

▷ Figure 5. Rocket, 1966, Gerhard Richter. Rakete, Rocket, 93cm x 73cm, Catalogue Raisonné: 110-2, Oil on canvas. Source: Gerhard Richter Studio.

the bayous to the immense rains that flooded the city (and were not absorbed by the asphalt and clay surface of the earth). RSA was trying to leave the grid; not just of the city but of its power systems and its energy protocols.

City as Clarified Energy (*Despite* Evidence to the Contrary)

Houston was well on its way to diversifying its economy in the 1990s—in the wake of the OPEC crisis of the 1970s, the city had embarked on a decentralization of its oil-based economy. The evidence of this change and its effect on urban form was vivid but was also not so startling: the changes were subsumed into a wider theory of polycentric and nodal based cities. The neatness of this logic thwarted a deeper discussion of the changes. The Galleria, an alternative downtown, had inaugurated an insular conflation of form and programs: a near singular event and interiorized spectacle in an otherwise sprawling network of freeways and nature. The Houston Medical Center—a regional economic engine—spanned Mexico and South America in its operational conception and imbued a constellation of hospitals, labs, and offices with a highly specific form of global wealth transference. These economic constructions began to dwarf the oil industry's downtown towers if not their economy. The city's bayou-based nature unwinding over and under freeways instigated among the willing a return to nature far more wild than the emerging world of "landscape urbanism." Lars Lerup seized on these seemingly fragmented effects in his declaration that Houston was a city of "megashapes"—an algorithmic unfolding of the city experienced in a private mathematics of partial evidence that if intuited momentarily reveals the whole.[5] Sanford Kwinter's work from *The Contemporary City* and *Incorporations* offered an alternative to the existential city, but it was Kwinter's more impatient writing in ANY that castigated a negative reading of the city: anyone who "still" relied on the "efficacy of negative dialectics" was "gullible," "what matters is infrastructure," wrote Kwinter.[6] Going further, he wrote, "form and architecture can no longer make the slightest historical claim on our attention." The invocation was to enter a realm of infrastructural

flows seeking an architecture within the means of flow. "What if time was real?" Kwinter asked (paraphrasing in part Gilles Deleuze).

RSA design studios tracked all aspects of time-based change—from laminar/nonlaminar flow of (bayous) to the demographic/racial contours of transit systems (city bus routes). Seeking to model the contour/currents—the differential modes and swarming of behavior, but also the dissonance that lies beneath the otherwise still surface of the city (its terrain vague). The "form" of the city only made sense as a flux; the fixed ordinary figure of the city was in time syncopated and realized as permanent change and intuited by an observer as time.

In a city once entirely based on an energy economy, RSA was slowly taking the city off the last century's literal and conceptual grid. We were clarifying spent energy, sensing the latent momentum of its aftereffects. Yet in all this discussion of energy sustainability is a term I have a hard time remembering even mentioned: energy was everywhere being lost in excessive strides yet *also* imaginistically recovered as an abundance of loss. We were more interested in oil that seeped from a power plant than the oil exported to other cities by pipeline. In Houston during the 1990s, it seems architecture was an instrument to abet the sensing of prior flows. Energy was a site and architecture at the same time—reining it in would be to curtail architecture's own possibility.

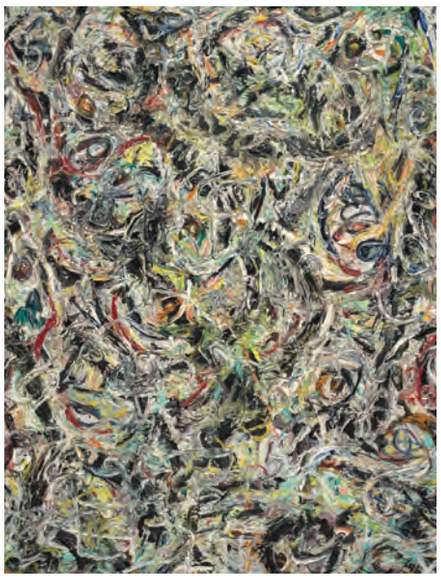
Part Two: Silicon Valley: Energy Management *After* Ethics

Solar energy from the sun reaches the earth's surface in eight minutes. Fossil fuels, oil, and gas form over 250–350 million years. Anyone involved in sustainability and energy know these measurements and have long sought a transformation of our energy regimes. Whatever the goals, the compensatory challenges have seemed intractably staged to stop change (and thus stage environmental calls to change as "revolts"). Blocking sustainability has been market based; there was too much easy money to make in the old energy regimes, too many assets based in fossil fuel protocols, too many stakeholders dedicated to the past. Whatever the source, energy expenditures, as we know, are bound to the very nature of modern life. Divided into nomenclatures of housing/office/retail or mobility/production/leisure. Embedded or transitory. Communications and (solid state) electronics (chips/transistors and batteries). Energy is our basis, and every move removes something from the earth and re-releases it into the literal and social atmosphere. If sustainability is an *ethical* question, we may concern ourselves with doing the *right* thing; if sustainability is a matter of survival, we had better find a path. Ethics tied to every step—anxiety and conflict. At the moment we cannot stop moving or consuming. Anxiety and conflict have often been a sustenance of sustainability debates, yet as Silicon Valley enters the energy markets, with a networked triad of hardware and software managed automobiles, batteries, and solar tiles, are we about to deeply alter the psychological profile of sustainability and its subject?

In the twilight of an oil empire RSA thrived: running out of time as we deplete millions of years of fuels in one and a half centuries. The ante was raised when we recognize that the inefficiencies are not particularly a choice: heating a home, driving children to school, or going to the grocery store. Millions of tractor-trailers and jets moving goods. Decades of environmental awareness lurk behind a culture that seemed then to reject the options we had—when we had them. We somehow missed them as either impossible (then) or at odds with markets and the faith we place in markets. It is important to place current innovations such as the Tesla Powerwall in this trajectory of innovation and conflict, especially if we imagine the consumer nature of the products as embedded in a scale of urbanization and infrastructure that we have often railed against. We could be heading toward a model of urbanization where mobility and low-density housing—sprawl—are positive modes providing a decentralizing of energy production and consumption. In this light, the ghost of Houston's fossil-fuel-fed sprawl is poised to be reimagined; it becomes a photovoltaic and battery enabled agrarian distance. Sprawl loses its association of guilt as a new denominator of solar production. The fact that most of the housing production in the United States in the last thirty years has been in the southern region adds to the case.[7]

Disguised Innovation

Housing in the United States is 40 percent more energy efficient on a per-square-foot basis than it was in 1980.[8] Yet houses are larger, and concealing the innovations negates the achievement. Here the eight minutes (light's arrival from the sun) return as a startling denominator: in significant parts of the United States (and the world), the sun's energy could replace the electricity generated from fossil fuels. In particular, in energy-intensive regions where cooling is predominant, solar energy could dramatically cut energy costs, and in areas where housing costs are relatively low, energy cost reductions could deeply offset shelter costs. It is possible that local energy production will be worth more economically than the



△ Figure 6. Jackson Pollock, "Eyes in the Heat," 1946, oil and enamel on canvas, 54 x 43 inches (137.2 x 109.2 cm). Courtesy of The Solomon R. Guggenheim Foundation, Peggy Guggenheim Collection, Venice, 1976, 76.2553.149.

buildings that support the equipment (photovoltaics, invertors, batteries). In that case, what we have long called housing, the hard asset of building and infrastructure, may be on its way to becoming a form of an agrarian rather than a mercantile asset. An instrument that recedes into the (economic) futures of its production—a house and its energy assets altering the national economy. Architectural theory, and a concern with the historical division of assets by markets, government, policy, and law, is here inverted to a near instant future energy protocol. It is, in effect, a switch from lack to abundance. The nexus inverted: instead of seeking sustainability to enable the extension of a former lifestyle (the house as a hard asset to be paid for, heated and cooled), here housing is a downstream by-product of an electromagnetic chemical action. Managed by artificial intelligence—a pulse of photons—a near autonomous process sustains itself above us unaware of our presence. The house does not know we are home.

Powerwall, glass photovoltaic shingles, and electric cars are upon us. We may be shifting—finally—to a chemical and physics-based discourse in architecture and urbanism. One where electromagnetics and chemical engineering take a place at the table of architectural denominators and where what seemed discontinuous and fragmented (the sprawling city) is now seen as potential (energy). That this is set within a paradigm of market commodities is startling and demands new theories and new means to imagine its potential and side effects.

It Was Never a Fragmented City: It Just Seemed That Way

OPEC's stronghold on oil helped crash the real estate market in 1980s Houston—opening a low-cost supply of land, a torus voided internal urban frontier often seen as an American Terrain Vague. Houston: an imbricated addiction to oil and a real estate market sustained and then made victim to it. To arrive in this city armed with the philosophy spanning Adorno to Tafuri invoked a euphoric but desperate query of the often-evacuated city. A city without zoning, built over a mad series of postwar decades suddenly emptied out and drained. Houston was both the most recent of American urban experiences and a prognosis of their failures. A fast buck city of postwar expedient building methods and millions of years old fossil fuels. A sensibility about architecture and urban life was uniquely formed against a backdrop of prehistoric energy (oil) and short real estate development. Architects thrive in the midst of the impossible to reconcile—architecture here becomes an instrument to help intuit the solution *if* not provide it.

Powerwall will, it seems, thrive here, and if so will change the very tenor of place and more so the ethos of our imaginations. The new solution is distributed into the very matrix that was seen as the problem: the sprawl is not disrupted by Powerwall but, I would venture, sustained and reinvented.

The fragmentation of Houston at the optic/visual (at the architectural) level was unavoidable and perhaps ripe for a discourse of semiotic crisis—everywhere were crass billboards looming over a no-mans land at street level that made Las Vegas seem quaint. If energy was not discussed as a factor to rein in (I recall space heaters competing with overly effective air conditioning in summer), it was ever-present in the discourse. Seen against the fragmented signage and inchoate zoning-free development, the city was also simultaneously total in its immense network of infrastructure—freeways, feeder roads, bayous, air conditioning systems—RSA quite exquisitely seemed to be liquefying the grids as a means to undo the seeming fragmentation. A work of architecture and its social aspirations in this milieu would seem an exquisite failure against that totality for all but the most academic disciplinarian. Yet in this realm, there was also a burgeoning claim on the wider aspects of the city's economy and its material spatialization: the city as *formation* rather than *form* ensued in the aftermath of money and energy. Things were a result of a conflation of energy, money, and procedure—buildings, cars, buses, housing were all placed because the economy *put* them there. The g-force induced navigation of a freeway cloverleaf was calculated into the road's radius and embedded in the

sidewall of a radial tire. Hardly fragmented but instead deeply constructed even as you circled a void of overgrown state property left derelict due to fiscal budgets. Living in a material/economic history, while it was often seen as a semiotic or linguistic crisis (in the manner of *Complexity and Contradiction*), we should be more likely to seek to change from within the economy and its materials. The denominator then was oil (and everything it powered and dimensionalized). But so too was oil as chemistry and a spatialization of chemical engineering. The school dealt with the aftermath of money (the city out the window) and also sought to enter its DNA. Slowly the semiotics of fragmentation were gone; beneath the surface, it was a deeply organized mixture of dimensional oil and every antecedent from real estate and its mortgages; from drywall and aluminum windows to mobility and distance. If it was fragmented, it was not the visual kind that mattered.

A city of dimensionalized energy, Houston was made specific at RSA even as it was also a nomenclature of the sprawling city common around the world. How do these dimensions change today as Silicon Valley enters the market of architectural and urban hardware—the Valley would do well to learn our urban histories even if to map their own markets? Tesla at their best use the markets to bring an art and chemistry to the fore as consumer products—the solar roof as an optical/chemical protocol that should unfold a spectrum of architectural innovation. Jackson Pollock's "Eyes in the Heat" (Figure 7) comes to mind as but one example of a visual project where light, material and chemical action induce a new human experience. Sustainability as art, experience and innovation might well be the real offer of Tesla.

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Eunjeong Seong is an Adjunct Assistant Professor of Architecture at Pratt Institute, where she has led a Thesis Studio focused on housing and urbanization. Eunjeong is a registered architect in New York, and her work has been exhibited at the Museum of Modern Art, at the Van Alen Institute, and in multiple galleries in China. Eunjeong is currently working on a manuscript on housing and energy innovation.

Acknowledgments
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Notes

1. See https://www.tesla.com/presskit#energy.
2. Tesla engineer Mike Pilliod, head of Tesla Glass, came to Tesla and the Solar Roof from Apple, where he was a ceramics engineer. Pilliod held a primary role in the glass components of iPhone 4 and 4S and in a new "topologically enhanced" silica molecule patented at Apple. The topological aspects of the chemical engineering helped bind but also segregate conducive components in the phone. With Wills Sweney, Pilliod contributed a Think Tank on urbanism, mobility, and energy coordinated by Michael Bell and Eunjeong Seong and hosted between Tesla, Stanford, and Columbia.
3. Michael Bell and Sze Tsung Leong, eds., *Slow Space* (New York: Monacelli, 1998).
4. See Mark Wamble, "Knee Play," in Bell and Leong, *Slow Space* (note 3), 221.
5. See Lars Lerup, "Stim & Dross: Rethinking the Metropolis," *Assemblage* 25 (December 1994): 82–101. "There seems, then, to be at least two readings of any megashape: one from the *inside* leading to an appreciation of the algorithm of the shape (or its *taxis*, to borrow from classical thought) and one from the *outside*, leading to an understanding of the whole—the *figure* (the result of the algorithm, once solved)."
6. See Sanford Kwinter, "Playboys of the Western World," *ANY: Architecture New York* 13, "Tate Frames Architecture: Cashes in on Culture Lottery!" (1996): 60–62. "Infrastructure must be understood as a broad term, a new, largely invisible materiality, much too big and serious and delirious for the magazine glad handers and the playboys with their desktop gadgets and pictures and special effects. Infrastructure is the systemic expression of capital, deregulated currency, interest rates, credit instruments, trade treaties, and market forces ... rail nodes and networks, television programming, interstate systems. Entry ports and the public goods and agencies associated with them (INS, NSA, IRS, FDA, ATF) ... epidemiological algorithms ... police enforcement matrixes ... in a word, grids of any and all kinds."
7. More than two-thirds of the housing realized in the United States since 1985 has been built in the southern region of the country. Source: Current Population Survey/Housing Vacancy Survey, Bureau of the Census, Washington, DC.
8. U.S. Department of Energy, Independent Statistics & Analysis, "Drivers of U.S. Household Energy Consumption, 1980-2009" (Washington, DC: Author, February 2015), https://www.eia.gov/analysis/studies/buildings/households/pdf/drivers_hhec.pdf.