Skyfarming

Bananas VARIETY: Cavendish. BENEFIT: Short gestation period, big fruit. Banana waste can be used to make paper 300x stronger than pulp paper. Carrots VARIETY: Nantes half-long, Danvers half-long, Pioneer, Spartan Bonus, Little Finger. BENEFIT: Rich in Beta-Carotene. YIELD: 185,139 sq ft @ 2336 tons/yr Cucumbers VARIETY: Conquest/Littleleaf (for pickling), and Jazzer, Superset and Marketmore (for slicing/salad). BENEFIT: Cucumbers have a successful history of urban greenhouse growth. YIELD: 107,639 sq ft, 911 tons/yr Eggplant VARIETY: Any. YIELD: 592,015 sq ft @1495 tons/yr Green Beans VARIETY: Any. BENEFIT: one of the most popular vegetables consumed worldwide. Lettuce VARIETY: Any. BENEFIT: All types of lettuce are well suited to hydroponic growth. YIELD: 130,243 sq ft @ 1003 tons a year. Peppers VARIETY: All colors—green, red, yellow, orange, purple, brown, black. YIELD: 223,889 sq ft @1368 tons/yr. Soybeans VARIETY: Hoyt. BENEFIT: High yield crop rich in vitamin A, carbs, iron and protein. Already grown in non-traditional environments, including on the International Space Station. YIELD: 2,314,241 @ 3285 tons/yr Spinach VARIETY: Any. BENEFIT: Iron-rich and traditionally successfully grown hydroponically. YIELD: 2,906,256 sq ft @3285 tons/yr Strawberries VARIETY: Nearly any. BENEFIT: Grown nearly exclusively via hydroponics in the US already, and are high in vitamin C, folic acid and water-soluble B. YIELD: 1,808,337 square feet @1514 tons/yr Tomatoes VARIETY: Nearly any. BENEFIT: Grow and yield very well hydroponically. YIELD: 392,883 sq ft @ 2737 tons/yr Wheat VARIETY: U.S.U.-Apogee "Super Dwarf". BENEFIT: Quick growth and non-edible chaff valuable to methane composting and power-generating. YIELD: 1,000,000 sq ft planted/yr Potatoes VARIETY: Nearly any. BENEFIT: Universally cultivated, very high in nutrients and carbohydrates. YIELD: 1,000,000 sq ft planted/yr Chicken VARIETY: Leghorn, Australorp, Dominique. BENEFIT: Efficient option for protein, as offspring yield is high each year. DOUBLE-BENEFIT: layers (for eggs) and broilers (for eating). YIELD: 95,232 sq ft to be tended. Fish VARIETY: Tilapia. BENEFIT: Hearty, fast-growing, tolerant to low dissolved oxygen levels and high turbidity. YIELD: 60,894 sq ft to be cultivated.

Food is energy. We feel this fact inherently, our bodies hinting to us every moment that what goes in is in some way related to what comes out—movement or cognition, action or ambition. But food also embodies energy in other ways: in the power transferred between sun and soil and seedling; in the context of activity expended to produce it—muscle pushing plow, combustion turning pistons; and perhaps most relevantly these days, in the energy spent in mass production, seasonless cultivation and endless transport. Energy that creates wonders like coast-hopping Georgian peaches and world-traveling

"The Living Tower" by Pierre Sartoux

Honduran bananas, and that brings us blueberries in the dead of winter, watermelon in the desert. ¶ Such is the dinner table of today—far-flung fruits and vegetables shipped by diesel barge, rolled cross-country from port to heartland in trucks, and flown in from far away cushioned on a trail of jet fuel. There are many things to be said about why farming, distributing, and eating food this way is a bad idea, long-term. But one of the most pressing, it seems, has to do with not just how we live, but where. ¶ In the next 50 years, it is expected that more than 80 percent of the world's population will live in or near a major urban center. This leaves less than 20 percent of us left to tend the farm—and feed us all. According to the Food and Agriculture Organization of the United Nations, in 2004, approximately 800 million hectares of land were used for food production worldwide, amounting to about 85 percent of all usable agricultural land. In addition, human population is expected to rise to somewhere between 8.5 and 10 billion in the next half-century. Add all of that up, and you get more mouths gaping in the world's concrete jungles, less crop-producing land available to fill those mouths, and even less willing bodies working longer and harder to grow anything at all. ¶ Just as the advent

of agriculture irrevocably changed the texture of human life, so will its eventual demise. Farming in the traditional sense is necessarily a horizontal endeavor—crop next to crop, stretching out over seemingly endless fertile ground. But now that that ground is waning (and population waxing), the need for more food to be produced, and for that production to happen closer to home is becoming urgent. Fortunately, a new breed of farmers are entreating us to literally "think higher" when it comes to the future of agriculture. ¶ The answer, as some see it, is vertical farming. One square city block, built 30 stories high—a skyscraper with the capacity to grow enough food to comfortably accommodate the needs of 10,000 people. ¶ The Vertical Farm is a project conceived by Dickson D. Despommier, Ph.D., professor of Environmental Health Sciences at Columbia University, and researched by several years-worth of students. It is a dissertation on urban environmentalism—detailed, deep-reaching, and the closest realization of a Jetsons-esque "World of Tomorrow" since the opening of Epcot Center. ¶ To understand, picture your typical caricature farmer. He is overall-clad, suntanned, John Deere cap cocked forward to blot out glare. He has sweat on his brow, a hayseed wedged squarely 'tween tobaccaoed teeth. He is a sepia-toned vision of our rural, food-bearing past. And he is for the most part already long gone from our fields, replaced by the machinery and corner offices of agribusiness. ¶ Now picture a new kind of farmer. He is clean cut and white coat-clad, an RFID scanner in hand, standing high above the city skyline, measuring humidity, temperature and Ph-levels in a luminous, glass-encircled grow room where strawberries hang like drying tobacco from hydroponic ceiling pods. He is the cultivator of the future—part scientist, part rainmaker, part high-yield container gardener—and his field looms just along our city skylines, close to home. ¶ At the core of the vertical farm idea is a back to basics mantra: do as nature does—just do it with a little technological goosing. Natural ecosystems are wonders of efficiency; closed structures where everything that is produced is used and eventually recycled to perpetuate the process of growth, usefulness, and death over and over. The vertical farm purports to mimic nature in a number of ways, but perhaps most significantly, it is designed to be a zero-loss, zero-emission wonder. ¶ If built, a vertical farm will be supremely energy efficient: utilizing wind, water or geothermal power (depending on location) and reap biomass fuel (methane) from the composting of its own organic waste. It will give back to the communities it lives in: not just in food products, but by natural remediation of black water, a process that uses non-edible "cleaner" plants like duckweed and cattail to recycle waste into potable H_2O. It will be inordinately efficient: yielding year-round crop production independent of climate restrictions or inclement weather. It will be socially leveling: putting abundant food nearer populations increasingly bereft of resources. And it will be connective: bringing a long-absent pride of place to food, something now lost in the virtually faceless, mass-harvested world of industrialized farming. In the world of the Vertical Farm, your food will be your neighbor, your farmer someone you could conceivably walk down the street and meet, and, if you are so motivated, you might even apply for a place along the food chain yourself, working within the structure. ¶ These things are of no insignificant value, as Despommier illustrates in the hundreds of pages of research available on the vertical farming project. But beyond the obvious benefits to a city-bound society that may soon be starved of basic nutritional building blocks, the vertical farm also serves a very important purpose to the world as a whole. ¶ "On the day after humans disappear, nature takes over and immediately begins cleaning house—or houses, that is. Cleans them right off the face of the Earth," says Alan Weisman in "The World Without Us." In that statement lies the more hidden, but globally meaningful benefit of vertical farming. In less than 50 years, says Weisman, left to its own devices, any ordinary home will crumble—fall to a heap of corroding metal and dissolving plastics and become overrun with an army of plants and animals. Truly, anyone who's been to the American South understands the rabid spirit of nature, and knows that a coup of this type is imminently possible. Take one look at a 20-foot retention wall overtaken with kudzu, and the sheer will of plant survival becomes evident. But it's also useful. The vertical farming project embraces this de-evolutionary theory, perpetuating "benign neglect"—intentionally allowing farmed ecosystems to go rogue as vertical farms around the world come online and take their place. ¶ It's estimated that one acre of vertical farm could be equivalent to as many as ten to twenty traditional, "2-D" acres, depending on crop type. Once released of its servitude to society's appetites, our farmed land—the whole of it the size of the country of Brazil—is expected to "cure" itself of the disease of industrial agriculture in less than a generation. In this way, vertical farming has the potential to not only save an increasingly city-bound humanity from starvation, but rescue whole ecosystems from being blotted out permanently. ¶ You could argue that both goals are essentially the same.

Vertical farm concept by Chris Jacobs

VIABLE TEST MARKETS

JAPAN

Japan is 73 percent mountainous and unable to support traditional agriculture. Also, the population eats a lot of fish, which is easily supported in vertical farming. Overall, environmental conditions in the country are not favorable for farming in the small areas available to be farmed, as the region is prone to typhoons, earthquakes and landslides.

ICELAND

Iceland is 10 percent glacier and has a population that is highly concentrated on the coasts. They also eat lots of fish, most vegetables must be imported, and the country is a geological hotspot (which makes geothermal power a possibility).

CUBA

Cuba suffers from variable precipitation and is hurricane prone. Vertical farms could decrease dependency on other countries for food.

MALI

Mali has high population growth, non-sustainable exploitation of natural resources and is heavily dependent on sometimes sparse rainfall.

NYC

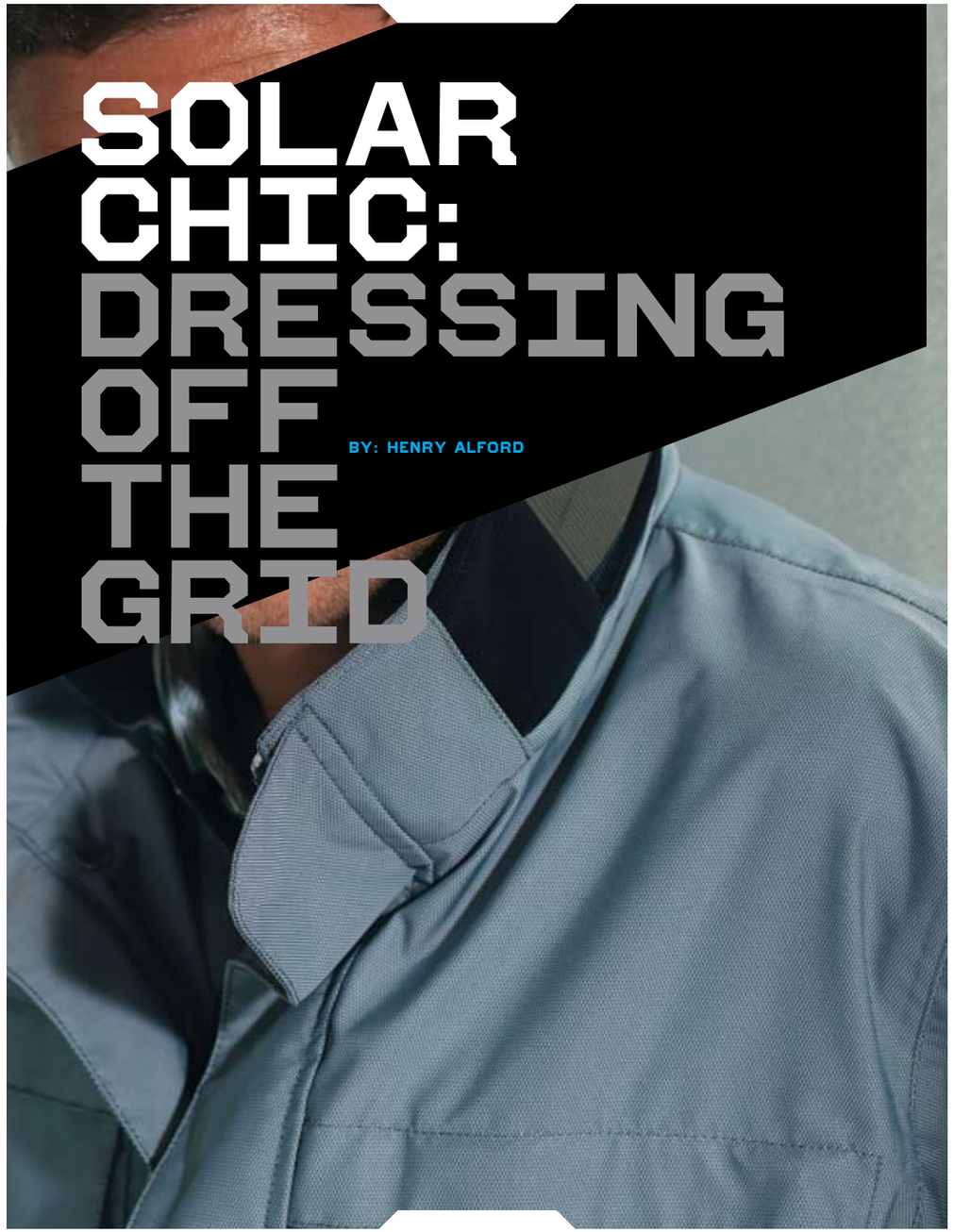
Nearly all food in Manhattan is imported, and the landscape presents obvious space constraints for traditional farming. But New Yorkers are uniquely ready to accept extreme or unusual methods and environmentally-friendly options, owing to a diverse culture, public-transit oriented population, and an energy-efficiency tolerance higher than in other urban areas.

PARIS

Parisians awoke to find their city's streets aflood with thousands of low-cost rental bicycles scattered about at hundreds of high-tech bike stations. The program, designed to cut traffic, reduce pollution, and renew a romantically relaxed pace of Paris life, also reinforces the French capital's commitment to clean energy and low carbon footprints begun by its widespread use of nuclear power. By the end of 2007, bicyclers will be able to travel via one of 20,600 bikes, retrievable at stations found about every 250 yards across the city. *Photo by Peter Macdiarmid/Getty Images.*

CONSPICUOUS CONSUMPTION OF CLEAN GREEN ENERGY

Kermit the Frog once said "It's not easy being green," a lament that might have made sense in a Muppet-fuzzy 70s haze, but today, would certainly be looked upon as at best lazy, and at worst a reproach to all that is good and holy in our souped-up, sustainability-conscious world. A 2007 Kermit might better say, "It's not cheap being green," and then open his wallet to recycling and remediation of Oscar's trash heap. The truth is, ever-ubiquitous green living is both high-conscience and high-fashion these days, as a burgeoning eco-industry continues to roll out some of the cleanest, greenest products ever conceived. Which is arguably wonderful. But, is it attainable? Like always, revolution has its price. ¶ It is strange to imagine technology that uses less could cost so much more, but, indeed it does, and $98,000 AC-powered roadsters and multi million-dollar sustainable vacation homes are proof that eco-consciousness is the newest status symbol designed to entice the fat of wallet and of carbon footprint. Wouldn't simply not owning a second or third home, or a fifth or sixth car—regardless of how "sustainable" it is—be infinitely more energy-friendly, you may ask? The answer is probably "yes," but that response would ignore one redeeming fact about the nature of early adoption. ¶ The "ultra-haves" are always the first to rush the front lines of the new, improved, and initially pricey. Whether because they really want to make a difference, or really just because they can, the wealthy green crowd often serves as both test-market and full-color, paparazzi-style advertisement for the newest gadgets and hottest toys. ¶ The September 24, 2007 issue of The New Yorker profiles one such piece of eco-bling. Writer Henry Alford took three weeks to try out Italian fashion-house Ermenegildo Zegna's new Sport Solar JKT—outerwear that powers iPods, cell phones and PDAs with no AC-plugging required. To say the jacket changed Alford's life is probably overstatement, but it certainly changed his mindset. Which is arguably wonderful. Here's to the thought that behind the solar glass of smugly-superior hydrogen converted Hummers and off-the-grid sustainable mansions, a similar, less expensive, revelation is working its way toward the rest of us.



SOLAR CHIC: DRESSING OFF THE GRID

BY: HENRY ALFORD

History has not been kind to garments that serve a function other than that of keeping their wearers warm or unnaked or adorable. You don't see a lot of people running around in chain mail these days, and the vogue for beer helmets—those baseball hats equipped with beer-can holders that allow the hat's wearer to drink beer through a plastic tube—seems to have stalled in frat houses. But I have hopes of better things for the Solar-Powered Jacket, a new item that the Italian firm Ermenegildo Zegna is launching later this year. Its heart is in the right place. Moreover, after test-driving the jacket for a three-week period recently, I can report that it possesses a quality quite rare in an article of clothing: utter unpredictability.

I started on the seventeenth floor of Zegna's offices, on Fifth Avenue, where Christian Lorey, one of the company's sales directors, issued me a prototype of a silvery-gray bomber jacket made of a breathable fabric called Microtene. Lorey is an ebullient man with a diamond stud in each ear and a fondness for the word "ciao." He pointed out two two-inch-by-three-inch solar panels embedded in the jacket's removable Nehru-style collar. The panels are wired to a battery in the breast pocket which is the size of a deck of cards; with four hours' worth of sun, the battery can be used to charge five- and six-volt appliances like cell phones and iPods.

Lorey sketched a few scenarios in which the solar jacket would be useful. "Say you've driven from San Francisco to Napa and you're having lunch at the French Laundry. You can leave the collar on your dashboard and let it charge while you eat," he said. "Or, in the Northeast or the Caribbean, it's great for boat owners-say, if you're on a boat for a week." I asked if the solar panels were fragile, and Lorey told me that if I took a hammer to them they'd break. He added, "But you can throw the coat in the back of your Bugatti and you'll be fine."

Putting on the jacket, I headed off for the No. 6 train—I'm riding it while my Bugatti is in the shop—eager to start charging my battery. Owing to a slight metallic sheen and to the verticality of its three-inch-high, solar-panel-bearing collar, the jacket attracts its share of stares on the street. "It's a solar jacket," I found myself explaining to one gawking passerby, who gave me a thumbs-up and said, "Beautiful." Over the next several days, I experimented with various methods of harvesting the sun's energy—with the collar both on the jacket and off—and then injecting this fiery goodness into my cell phone and iPod. I loved obsessing over the positioning of the three-inch-by eighteen-inch removable collar in my office window as I tried to make it soak up the sun's rays as effectively as possible; I was reminded of tanning, or of grilling eggplant. One day, outside a café, I sat on a bench with my feet pulled up in front of me so that my knees were shoulder height; I dangled the two shiny black solar panels over my kneecaps, like some sort of Sierra Club pasties. The peak experience, though, was the first time I juiced my iPod with the power of the sun; I whooped with joy, and wished Al Gore were present.

During these initial forays, two things quickly became clear. First, the solar panels wanted to be in direct sunlight—in hazy or diffuse light it could take as long as twelve hours to charge the battery fully. Second, solar energy—or solar energy as filtered through the lens of a fashion designer—is mercurial. Though my iPod had easily taken a complete charge from the battery, I could never get

Studies find that China is building about two new power plants each week.

more than a forty-one-per-cent charge on my cell phone. Stranger still, seemingly identical weather conditions on different days would produce varying results; one day's four hours of direct sun would charge my phone thirty per cent, another's only sixteen per cent. Moreover, the battery's light sometimes flashed when it was not supposed to.

I decided to investigate what other gizmos the solar jacket might be able to charge. At B & H, a huge electronics store, I plugged myself into an MP3 player but was unable to power it. A friendly salesman wearing a yarmulke wasn't able to help me, but he was entranced by the solar jacket. Tugging it and me toward him, he said, "Let me take a closer look at this wonderful thing. Is it your own gimmick?" I said it was not. He inspected it further, impressed. I told him, "I'm hoping to go off the grid entirely. I'd like to become a self-sustaining scientific marvel, like Carol Channing." He nodded. "Very nice."

I returned to Lorey to ask for trouble-shooting advice. I told him about the battery's moodiness. He reminded me that I was wearing a prototype, and that the battery on the finished jacket would be lithium, not alkaline, as mine was. He encouraged me, when collecting sun with the collar removed, to prop the collar so that it stood straight up, like a Richard Serra sculpture, rather than lying flat. (From then on, I adopted this policy.)

Having resolved to transcend the limitations of my equipment—would Copernicus be Copernicus if he'd spent all day whinging about the humidity?—I stepped up my efforts. The amount of solar energy intercepted by Earth in one day, according to the Renewable Resource Data Center, is greater than the amount of energy the country uses in an entire year—but that doesn't mean it's going to fall neatly into the solar receptors hanging around your neck. I needed to adopt a more aggressive stance toward battery-charging.

Once I did so, I had excellent results, and I made a lot of new friends. While eating lunch at the Carnegie Deli one day, I asked the manager if I could charge the collar in the restaurant's front window. He huffed his assent, like a football coach: "Go! Go! Go!" I went. Twenty minutes later, I discovered my waiter gesticulating wildly near the collar, explaining what it was to two of his colleagues; when I walked over, he put the collar around my neck and playfully pretended to electrocute me. At La Goulue, on upper Madison Avenue, a smiling hostess suggested that I sit at a table on the sidewalk and drape the jacket over the back of a chair; during the meal the restaurant's debonair headwaiter came by and pretended to "cook" his hands over the panels. (My lunch companion observed, "Tech breaks down barriers.") Another day, I asked the suave captain in the Grill Room at the Four Seasons if he would prop the collar in the restaurant's window. "Certainly," he said, and then joined me at the bar to tell me about the time he'd used solar panels on a boat. The only friction I encountered while charging occurred at a Starbucks, where a preppy young executive sat next to me at the counter, facing the street. Upon seeing me break in half a pile of wooden coffee stirrers to prop the jacketless collar into an upright position, the man flashed me a seasick look and then fled to another part of the store.

After a friend told me that roadside venders in remote parts of Africa use car batteries to charge customers' cell phones, I spent part of an afternoon sitting in front of a café near my office, in the Village, asking people if I could "juice" their cell phones with solar power. I met with three demurrals (a hipster woman in her twenties: "I really can't take any chances today"), one phone for which I didn't have the proper adapter tip, and a reluctant "O.K." This last individual—a bearded N.Y.U. grad student-seemed enthusiastic until, some twelve minutes into the process, he stood up abruptly and said, "Uh, I should get going?" We sheepishly uncoupled, and I thought, he is so late adopter.

I wondered what other appliances my jacket might be able to power. A visit to the Web site usbgeek.com brought into my life a small flurry of gadgets equipped with USB ports—these are the same gadgets, such as little fans, whose USB, or universal serial bus, connections allow people to run them off their computer. Though the tiny vacuum cleaner for my computer keyboard (twelve dollars) has provided distraction and solace during my workdays, it is the eight-inch-tall refrigerator (thirty dollars)—it chills one can of soda—that most impresses me: I'm using the sun to chill the liquid that slakes the thirst that's created by the sun. The circle of life, etc.

Could I power five- and six-volt appliances if they didn't have USB plugs? One day, I put seven of my small household appliances into a shopping bag and went to my local Best Buy to find out. I told John, a skinny general manager there, about the solar jacket. I pulled my electric mixer out of the bag and said, "I'd love to get off the grid with this." John said that I'd need a tip that goes from female AC to male USB, adding, "And I've never seen anything like that." Unwilling to be stymied, I went to my office and phoned more than a dozen electronics stores listed in the Yellow Pages before finding one—a repair shop called Hi-Tech, on the Lower East Side—that was willing to work with me. Hi-Tech is a busy place owned and operated by Frank Farooq, a Teddy-bear-like Pakistani in his late forties. For ten dollars a pop, Farooq and his young Russian employee, Irene, were willing to cut the cords off my small appliances and solder them to USB cables. The project did not initially excite Farooq—"This is not normal," he said. Our first success was a six-inch-long fluorescent utility light; its milky, nacreous glow seems all the more lovely for being powered by the star nearest Earth. On first seeing its light turn on, I raised a victory fist in the air and yelled, "We'll take down the grid!" Farooq made a fist, too, and said, "I'm ready!" On my next visit, Farooq and Irene successfully powered a Canon P1-DH palm-printer calculator for me. Alas, their efforts to solar-power my Black & Decker cordless Detail Shrubber, for trimming hedges, resulted only in semi-success: the Detail Shrubber's six-inch blades gnash once or twice before they poop out and stop altogether.

I walked around with the utility light in my jacket for about a week. When I went to see "The Simpsons Movie" down at Battery Park one night, I used the light to help retrieve a quarter I'd dropped on the theatre's sticky floor; I've also employed it, hidden inside my jacket, to give myself an eerie glow when in the presence of small children. Over time, the joy that solar power initially conferred on me has deepened, and is now mixed with the kind of smug self-regard that can come only after generous expenditures of time and effort. I saw a Greenpeace volunteer on the sidewalk in midtown the other day. I asked him for a donation.

A "massive loss of power" occurs in Baghdad, Iraq after militia groups seize control of electrical switching stations around the embattled country.

Entia non sunit multiplicanda praeter necessitatem.*

FRIAR WILLIAM OF OCKHAM, 14th Century, A.D. re-stating the lex parsimoniae (law of parsimony) that advises one make as few extraneous assumptions as possible in the pursuit of clear scientific theory—a statement also known as "Ockham's Razor."

** Entities should not be multiplied beyond necessity.*

LESSON ONE: The simplest answer is usually the best one.

The 21st century has afforded us countless techno-sustainable innovations, each more complex, scientific, and Jetsons-esque than the next. This is not to say that they are not needed or helpful, but considering humankind has warmed homes in frozen places, cooled them on the hottest of days, and existed in the most extreme locations for centuries without solar panels, low-e glass and 3D wind studies, it seems we might be missing something—or maybe just forgetting it.

In the fall of 2007, architects from Cooper Carry's Atlanta office endeavored to find out. Through research of ancient architectural forms, long-gone civilizations, and the homes of some of our closest ancestors, they discovered something interesting: That energy ingenuity was definitely not born the day "An Inconvenient Truth" hit theaters; that there's a wealth of ancient "technology" applicable to our modern society; and that even in the 21st century, the simplest answer might still be the best one.

DOGTROT HOUSE 1800-1900 ▼ When 19th and early 20th century settlers in the Southern United States found their one-room cabins too small for their growing families, they looked for ways to expand. Unfortunately, log cabins are much like legos, and require some disassembly to add or subtract walls. So instead, they built more cabins and connected new to old with covered breezeways called "dog trots," so named for their pets' tendency to pass through them. Besides adding extra room, these shady, tunnel-like areas served as perfect passive ventilation systems—cooling both cabins efficiently without freon or fans.

HANGING GARDENS OF BABYLON 600 BC ▲ Though there is some question as to whether this wonder of the ancient world actually existed, King Nebuchadnezzar II's 100 by 100-foot, 75-foot-high, vaulted green space can be imagined as the very first "living roof." Besides the garden-top's function as a gift to the King's homesick, mountain-born wife, no one really knows what the space beneath the living canopy was used for (save as housing for the pumping mechanisms that drew water from the Euphrates River up to the greenery). But because of what we do know about living roofs today, we can suppose that the thermal resistance value of the dirt necessary to grow the garden's mature trees made for a temperate and probably surprising retreat from ancient Mesopotamia's arid climate.

CAVES Dawn of Time–Present ▼ From China to South America to the American Southwest, digging your own hole (or simply occupying a naturally-formed one), has been the housing model of choice for thousands of years. And really, the ancients had something there: Caves are, climatically speaking, rather comfortable. The thermal mass of mountain ranges keep things temperate all year round beneath the surface, making man-made heating and cooling systems unnecessary. Also beneficial is the fact that if you're living in the land, you're not living on it. Fewer lawns and less tree removal means more natural landscape—and a healthier planet overall.

VILLA BARBARO 1560 A.D. ▼ Scoring the 16th Century Villa Barbaro near Venice using current LEED® Version 2.2 criteria might offer this marvel of ancient architecture 16 out of 19 possible points in the program's Sustainable Sites and Water Efficiency category. The reason: The Villa—architect Andrea Palladio's masterwork and home to Venetian ambassadors the brothers Barbaro—has a better handle on greywater usage and recycling than most modern eco-homes. Rainwater is collected in several fountains and fishponds on the Villa's grounds then leaves the lawn to run through the kitchen and then irrigate the home's gardens. It then travels downhill to fill two more fish ponds, waters horses along the main road, and then finishes its journey in the orchards, where it waters a large selection of fruit trees.

HYPOCAUST 9th Century BC–5th Century AD ▼ Literally meaning "heat from below," a hypocaust is an ancient Roman system of central heating that helped keep the public baths and opulent private enclaves of the ancient empire warm. Flooring in the baths was raised on pilae stacks (towers of thin, square tiles) creating a chamber where hot air and smoke from wood-fired furnaces would circulate then escape through flues in the structure's roof, thereby heating, but not polluting, the rooms. The only problem with hypocausts was their actual cost—as servants had to be procured to stoke boilers and control the sometimes raging flames beneath the bathrobed elite's feet.

WIND TOWERS ? BC - Present ▶ Persian days are brutally hot. Persian nights, often blisteringly cold. Wind towers (also called windcatchers) even the climatic playing field through simple physics. Built atop a qanat (an ancient water management system that consists of rushing, below-ground streams), a wind tower pulls water-chilled, subterranean air up through a living chamber or refrigeration room by using the Coanda effect—the tendency of a stream of air to stay attached to a convex surface rather than follow a straight line. Someone closes all ports at the top of the windcatcher except for the one facing away from oncoming wind, and cold air is drawn upward and outward, chilling everything in its path.

BATHS AT OSTIA 150 BC ▼ Just one of the hundreds of known Roman bath locations excavated in Italy, the Baths at Ostia featured a notably simplistic method for heating its various lounging pools. The westerly façade of the compound consisted primarily of large windows wide open to the afternoon sun. The Roman's described it as a heliocaminus—literally a "sun-furnace"—a room heated solely by the rays of the sun. Today, we call it "passive solar," the simplest, cheapest, most mechanically uncomplicated way to heat a home.

Taiwan's last tribal outpost without electricity receives power polls—sparking debate over cultural singularity, and the future of "The Dark Village."