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Solar Power's American Ascent

Power from the sun is surging in the United States. Realizing its vast potential invites us to make creative but careful use of our built environment and open lands

By Philip Warburg

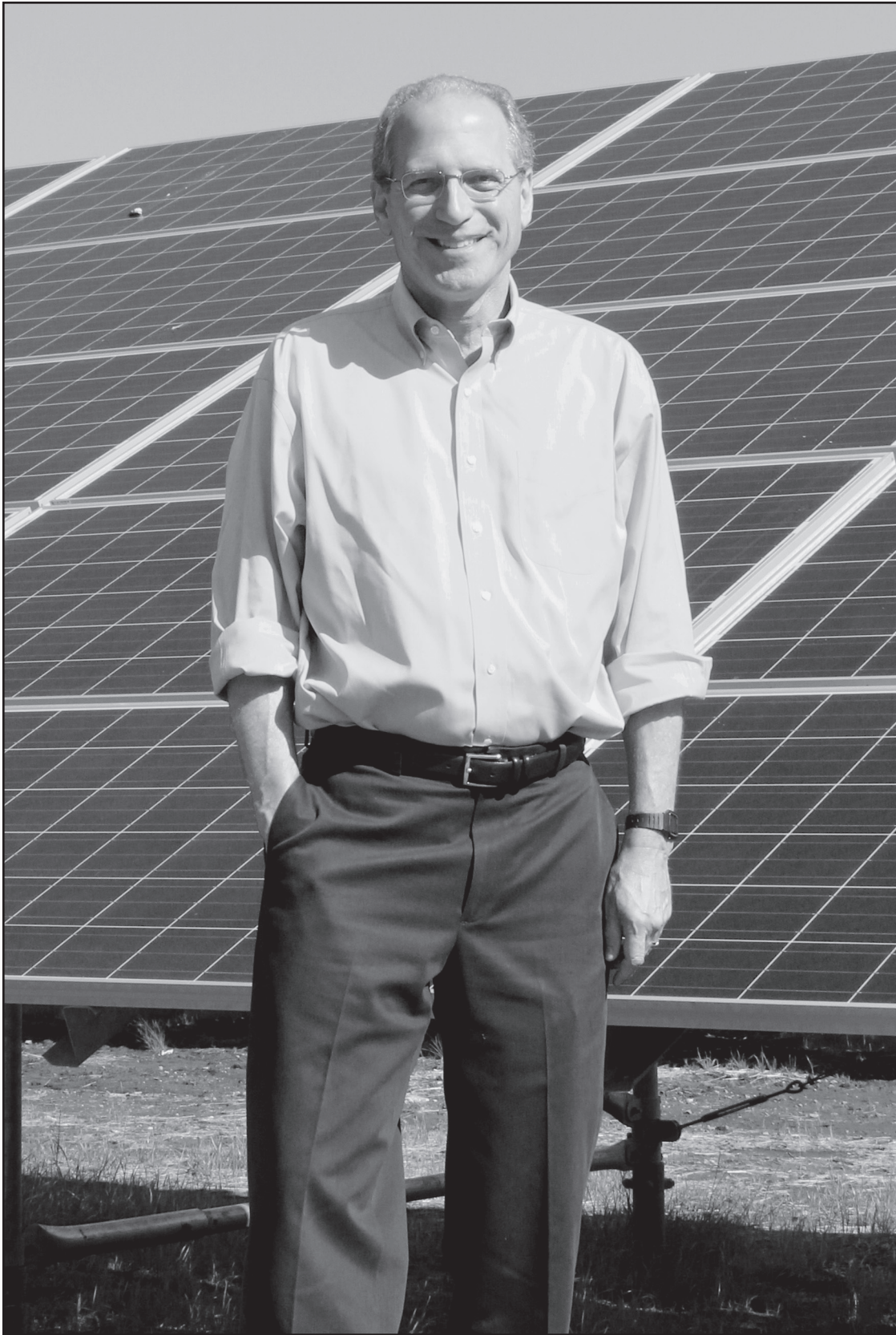
Solar energy's time has come. Just a few years ago, as I was putting the finishing touches on a book about wind power, friends asked if my next would be about solar. I dismissed the idea at the time. If I ever wrote a book about solar, I told them, I'd have to call it *Dim Sun*.

How things have changed! On my computer screen, I marvel at the steady tick of kilowatt-hours produced by our home's rooftop solar array. It generates about three-quarters of the electricity we need to run our appliances, light our rooms, and keep a hybrid electric vehicle fully charged. Every year our solar panels spare the globe about 3.6 tons of CO₂ emissions from the coal- and gas-fired plants that still supply most of New England's power.

At last we have entered an era when solar energy is not just an environmental virtue but is also a boon to the economy. Nearly 800,000 American homes and businesses now have solar power, and almost 174,000 U.S. workers have found jobs in the solar industry. Those jobs will grow in the years ahead, as solar energy reaches millions of American homes, businesses, farms, public buildings, and the portfolios of power companies large and small. Over a century has passed since Albert Einstein identified the sun's photoelectric effect in 1905 — a discovery that later earned him the Nobel Prize for Physics. I can only imagine how delighted he would be by our progress, however belated, in harnessing this formidable source of power.

Americans today are investing more money, and greater hope, in solar energy than ever before. Along with shrinking manufacturing and installation costs, favorable policies at the state and federal levels have created whole new cohorts of solar stakeholders ranging from homeowners and businesses to electric utilities and financial institutions. During 2014, a new solar system was completed at the rate of one every 2.5 minutes, reflecting an overall investment of \$17.8 billion that year. Even more impressive is solar power's share of U.S. investment in new electrical generation. In 2014, solar accounted for 32 percent of all new generating capacity, outpaced only by natural gas power plants, which captured 42 percent of new capacity. Wind came in third, at 23 percent, while investment in new coal plants was negligible.

Much more than an echo of our flirtation with renewable energy in the 1970s, solar power is part of a sea change that is sweeping through university labs, think tanks, and corporate boardrooms, where recognition is growing that a fundamental shift away



This article is adapted from Philip Warburg's new book *Harness the Sun: America's Quest for a Solar-Powered Future* (Beacon Press, 2015, \$27.95). His first book on renewable energy, *Harvest the Wind*, was published by Beacon in 2012. Phil was president of the Conservation Law Foundation from 2003 to 2009, and previously directed the Israel Union for Environmental Defense in Tel Aviv. From 1989 to 1997, he was an attorney at ELI, working on Central and Eastern European law reform and Middle East environmental cooperation.

from carbon-based fuels is imminent and inevitable. The devastating impacts of climate change may be too seldom acknowledged by our political leaders, but the overwhelming scientific evidence has persuaded technology innovators as well as broad segments of the public to embrace a major push toward renewable energy.

Solar electricity supplies less than half a percent of America's power today, yet it's no idle dream to foresee a quarter or more of our electricity coming from the sun in a few decades' time. The National

Renewable Energy Laboratory has estimated America's solar potential at more than a hundred times our total electricity consumption, with rooftop installations alone capable of supplying over a fifth of our power needs — a contribution that could grow as solar technology improves. The same government lab has projected that solar and wind power could provide almost half of America's electricity by 2050, using technology that is commercially available today. These technologies, together with hydro-

power, biomass-fueled power plants, and other renewable sources of electricity, could generate 80 percent of our mid-century electric output, NREL predicts. Imagine the impact that would have on America's carbon footprint.

Despite all this promise, the United States has some catching up to do. We may have far greater land resources and sunnier weather, on the whole, than much of Europe, yet we lag far behind many European nations in our per capita use of solar power. Germany leads the world in both per capita and total use of solar energy, despite its notoriously gray climate. A highly publicized 100,000 Roofs program got the ball rolling back in 1998, and vigorous subsidies raised that country's solar power to 438 watts per person by 2013 — almost 12 times our own reliance on the sun, which stood at 38 watts per capita that year. Italy and Belgium tied for second place with 285 watts of solar power per person; they were followed by Greece and the Czech Republic. In all, 18 European countries delivered higher per capita solar use than the United States.

But American solar power is growing fast. By the end of 2014, we had enough solar electric-generating capacity to supply all the needs of four million American households. The solar power installed during that year alone amounted to nearly half of all previously installed capacity. If we can maintain that momentum

in the coming years, a robust, solar-powered future is within our reach.

My personal solar journey began in our century-old home, just a short trolley ride from downtown Boston. I have spent most of my career as an environmental watchdog, railing against corporate polluters and advocating for cleaner energy. My wife, Tamar, is an architect who has designed many green buildings for others. As the price of solar panels spiraled downward in recent years, we decided it was time to make renewable energy a part of our personal as well as our professional lives. Our new solar array does just that.

Installing solar panels on our home was the beginning of an exploration that took me to football arenas, big-box stores, industrial warehouses, and college campuses where the sun's energy is being tapped. I also visited cities, towns, and counties whose political and business leaders are pioneers in advancing solar energy. Some of these communities defy easy stereotypes about renewable energy as the domain of enlightened liberals and well-to-do suburbanites. In Lancaster, California, ultra-right-wing mayor Rex Parris has set his formerly crime-ridden city on a course to becoming what he brashly calls "the solar capital of the world," where solar power is mandated in all new residential neighborhoods, PV panels have been installed on nearly all public buildings, and utility-scale solar power plants are quickly going up on vacant land within the city's borders. Lancaster's demographics contrast sharply with upscale, super-progressive Marin County, where clean energy maverick Dawn Weisz has waged a successful campaign to create a community-based alternative to buying up power from utility giant PG&E. Here in my home state of Massachusetts, I saw how political savvy has fused with economic acumen to make the working-class city of New Bedford, once a center of whale oil production, a state leader in solar energy development.

America's brownfields — our abandoned or under-used industrial sites — are a huge, yet largely unrecognized solar resource. My travels took me to several of these sites: a garbage mountain overlooking lower Manhattan, a contaminated former factory site on Chicago's South Side, and a rocket propulsion test site east of Sacramento were among them. On these visits I met entrepreneurs and community leaders who have succeeded in turning gritty wastelands into renewable

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energy powerhouses. According to the Environmental Protection Agency, harvesting the sun on brownfield properties like these could supply three times our total electricity needs nationwide.

Appealing though it may be to capture the sun's energy as it falls onto our built environment, some of our greatest solar power opportunities lie outside our cities and towns, in open spaces where we can build solar farms that — at their peak — can match the output of coal- and gas-fired generating stations. By deploying solar technology across thousands of acres, we can also achieve economies of scale that are beyond the reach of smaller, scattered solar installations on our homes, commercial and public buildings, and urban brownfields. About half of all solar power in America today comes from sprawling solar complexes like the ones I visited in the Arizona, California, and Nevada deserts. With proper access to the grid, these renewable energy power plants can be vital suppliers of electricity to major metropolitan areas hundreds of miles away.

America's open spaces make for easy construction of large-scale solar power complexes, but I quickly learned that one person's undeveloped land is another's biodiversity treasure. Solar developers and conservationists are working hard — and often together — to ensure that utility-scale projects, when built, pose minimal harm to vulnerable earthbound species like the desert tortoise and the giant kangaroo rat. They are also grappling with the risks posed to bird life by solar power towers, which use thousands of giant mirrors to convert the sun's heat to electricity-producing steam.

My travels also took me to a number of Native American communities, where I spoke with tribal officials and entrepreneurs about the solar initiatives that they are beginning to advance. Some tribal leaders see solar power as a way to build a more sustaining and respectful relationship to traditional lands while bringing much-needed income to their tribes. Others suspect that solar projects may simply be the latest attempt by non-Native peoples to exploit tribal energy resources. They remember the uranium mines that sickened so many of their people until they were finally banned a decade ago — on Navajo lands at least. They are intimately aware of the hardships as well as the economic gains that have come from the coal mines and coal-fired power plants that they allowed to be built on their reservations. The jobs were — and still are — desperately needed, but at what cost to their traditional landscapes and their people's health?

Making the sun a major American energy resource

isn't just about building new power plants; it's also about producing and responsibly handling all the equipment we need to harness the sun's energy. Along with taking the pulse of American solar manufacturing in the face of fierce competition from China, I investigated some of the knottier issues of solar waste management that will emerge in the years and decades ahead. Industry leaders will soon need to come up with a responsible way to deal with the billions of discarded panels and other solar hardware that will accumulate as we ramp up our use of solar power.

Of paramount importance are the state and federal policies that are now making it possible for solar energy to compete in a marketplace still dominated by carbon-based fuels and nuclear power. Are energy pundits exaggerating when they warn of a utility death spiral brought on by a shift to solar and other decentralized modes of power generation, storage, and use? Is there a new role for electric utilities in balancing these new energy resources with conventional means of electricity generation and distribution? In grappling with these questions, I sought out the wisdom of cool-headed analysts and the emboldened visions of industry iconoclasts.

America's shift toward solar power is one piece of an enormously challenging puzzle. Our glaciers are already melting; our oceans are warming; and extreme weather events are exacting a mounting toll on human communities, natural habitats, and vulnerable wildlife species. What we are witnessing is no more than a gentle preview of the havoc that awaits us if we ignore the overwhelming scientific consensus about rising greenhouse gas concentrations and their global impact. Left unchecked, the burning of fossil fuels will disrupt the lives of millions of people, raise the specter of war over food and water scarcity, and irreparably damage terrestrial and aquatic ecosystems.

As one of the biggest producers of the greenhouse gases that threaten our global environment, America has a duty to lead the way, rather than lag behind, in making these momentous shifts. Through the personal choices we make, the policies we adopt, the technical genius we apply, and the entrepreneurial spirit we engage, we can make a difference. **TEF**

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