Fossil to Solar & Wind

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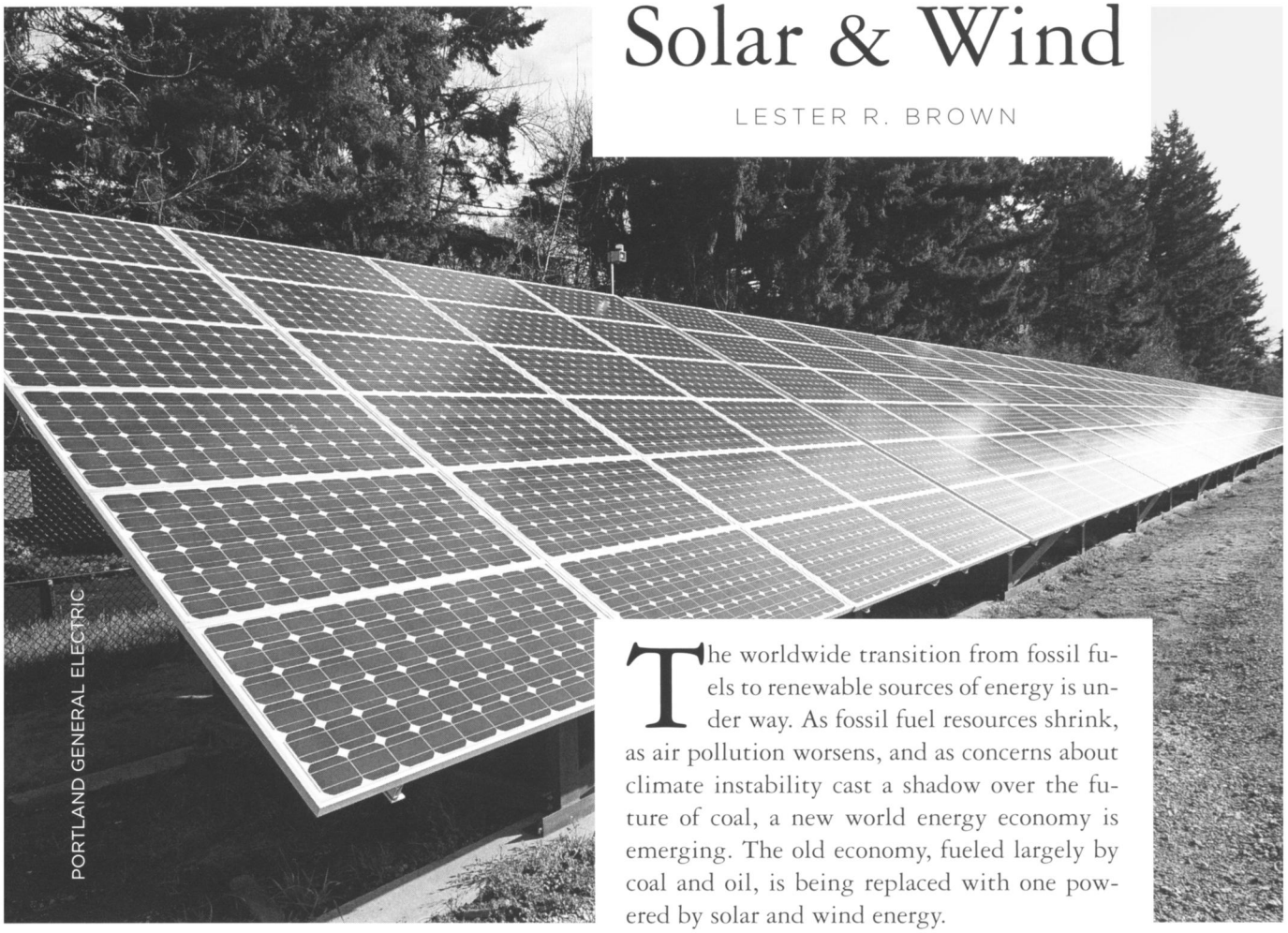


PORTLAND GENERAL ELECTRIC

The worldwide transition from fossil fuels to renewable sources of energy is under way. As fossil fuel resources shrink, as air pollution worsens, and as concerns about climate instability cast a shadow over the future of coal, a new world energy economy is emerging. The old economy, fueled largely by coal and oil, is being replaced with one powered by solar and wind energy.

CLIMATE CHANGE TAKES CENTER STAGE

Climate change has a short but alarming history. From the first Earth Day in 1970 to the upcoming United Nations Framework Convention on Climate Change Conference in Paris in December, fewer topics have sparked greater debate, alarm, and demand for action. Our Timeline tracks the progression of the climate change movement in relation to the rise of the Earth's global average temperature, estimated at 58 degrees Fahrenheit in 1969. From treaties to discoveries, natural disasters to global conferences, key moments are plotted here.

Compiled by Patrick Balbierz and Jordan Clifford
Source: NASA Global Temperature Tracker
Designed by Meehyun Nam-Thompson

TRANSITIONS

In 2014, Denmark got 43 percent of its electricity from the wind. Portugal and Spain each got over 20 percent, and Ireland got 19 percent of its electricity from wind power. Indeed, on some days wind power supplied half of Ireland's electricity. During several days in August 2014, electricity generated from wind in the United Kingdom eclipsed coal. In South Australia, wind farms now supply more electricity than coal plants. In China, electricity from wind farms has eclipsed nuclear power plants. And water for 170 million Chinese households is heated by rooftop solar water heaters.

In the United States, the energy transition can be seen in the hundreds of utility-scale power plants under development or construction in the Southwest. Iowa and South Dakota are each generating at least 25 percent of their electricity from wind farms. The share in Iowa could reach half by 2018. Texas, the heart of the mainland United States oil production and distribution, now gets 10 percent of its electricity from wind and is building huge wind farms and long-distance transmission lines that will enable it to sell low-cost, wind-generated power in Louisiana and Mississippi.

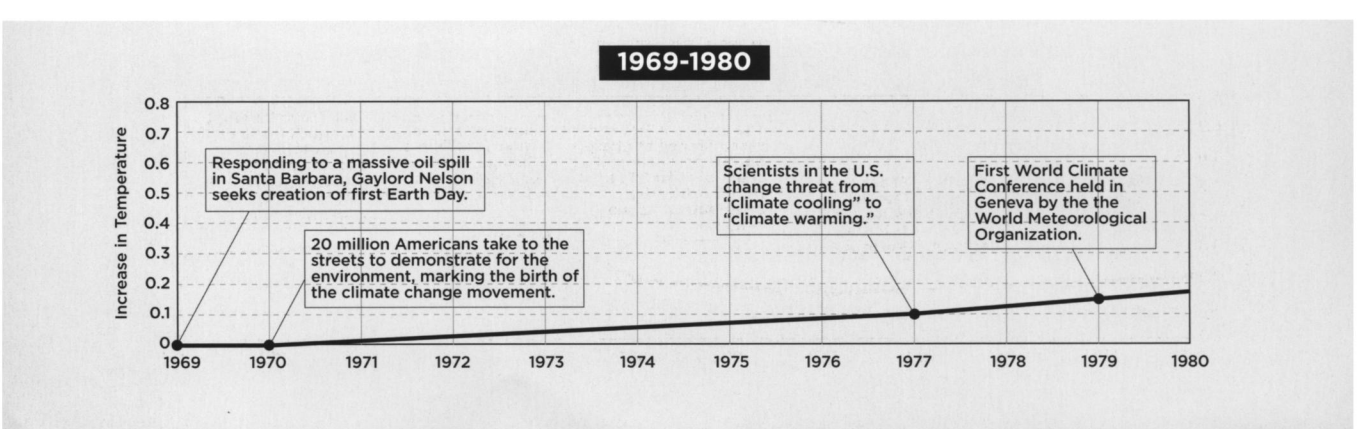
The worldwide use of solar cells to convert sunlight into electricity is expanding by over 50 percent a year. Early photovoltaic (PV) installations were typically small-scale—mostly on residential rooftops. Now, in addition to millions of rooftop installations, thousands of utility-scale solar projects are under development or construction. At peak power, the solar systems installed worldwide by 2014 could match the output of at least 100 nuclear reactors.

DRIVERS OF THE TRANSITION

Much of this dynamic is underpinned by costs. Both solar- and wind-generated electricity, whose costs are falling fast, are undercutting fossil fuels in an ever broader number of electricity markets. A July 2014 study by the government of Denmark projects that new wind farms coming online in 2016 will supply electricity at half the cost of coal and natural gas plants. In parts of Australia, which are experiencing a solar boom, the cost of producing electricity from the sun has fallen well below that generated by coal-fired plants.

Falling costs for solar and wind are also opening the door for massive investments in Africa. Bloomberg New Energy Finance

Lester R. Brown is author of The Great Transition: Shifting from Fossil Fuels to Solar and Wind Energy *with Janet Larsen, J. Matthew Roney, and Emily E. Adams, published in May 2015 by W.W. Norton & Co. This article is excerpted from this new book.*



reported that there would be more renewable energy installations in Africa in 2014 than during the preceding 14 years.

Several concerns are driving the great transition from fossil fuels to renewables. One of these is worry about climate change and its effect on our future. Another is the health impact of breathing air polluted by burning fossil fuels, as seen in the 3 million people who die each year from illnesses related to outdoor air pollution. A third is the desire for local control over energy production and overall energy security.

In response to these broad-based public concerns, government policies—including emissions controls, official renewable energy targets, and financial incentives—are encouraging the shift to solar and wind.

And as the need for clean alternatives to coal and oil becomes apparent, there is growing interest in solar and wind energy within the investment community. This includes not only investment banks but also several billionaires, including Warren Buffett and Ted Turner, who are plowing vast sums of money into renewable energy. The influx of "smart money" into this relatively new segment of the energy economy suggests that much more investment will likely follow.

WINNERS AND LOSERS

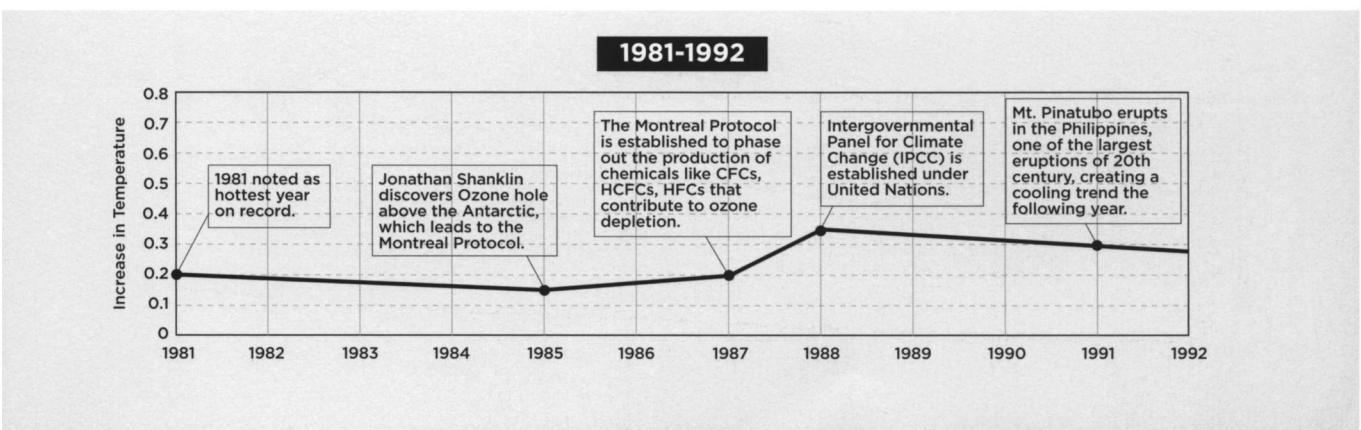
In this transitionary period, homeowners are the big winners because they can use their rooftops to generate their own electricity. From a business perspective, companies that manufacture and install solar panels are expanding rapidly. The case is similar for wind turbines. Annual growth rates in wind and solar installations will likely range from 10 to 20 percent in the years ahead as the energy transition brings unprecedented investment and employment opportunities. In the broadest sense, though, everyone who breathes cleaner air and benefits from a more stable climate regime will come out on top as the energy transition proceeds.

> THE ENERGY TRANSITION WILL CHANGE NOT ONLY HOW WE VIEW THE WORLD BUT ALSO HOW WE VIEW OURSELVES.

Among the losers are the big multinational, independent oil and gas companies, including Chevron, ExxonMobil, and Shell—three of the industry giants. These three firms combined spent a half-trillion dollars between 2009 and 2013 to expand oil and gas production. But even with this hefty investment, their production declined in 2013. Each company suffered a drop in profits.

A NEW WORLDVIEW

The energy transition will change not only how we view the world but also how we view



ourselves. With rooftop solar panels capable at once of powering homes and recharging car batteries, there will be a personal degree of energy independence not known for centuries. We will also be dramatically reducing carbon emissions, setting the stage for stabilizing the Earth's climate.

Our relationship with the natural world will change from one where we are in conflict with nature to one where we are again in sync with it. Instead of seeing ourselves apart from nature, we will see ourselves as an integral part of the natural system. Smokestacks that dirty the air and alter the climate will be replaced by solar panels residing on our rooftops and fields of turbines turning gracefully in the wind.

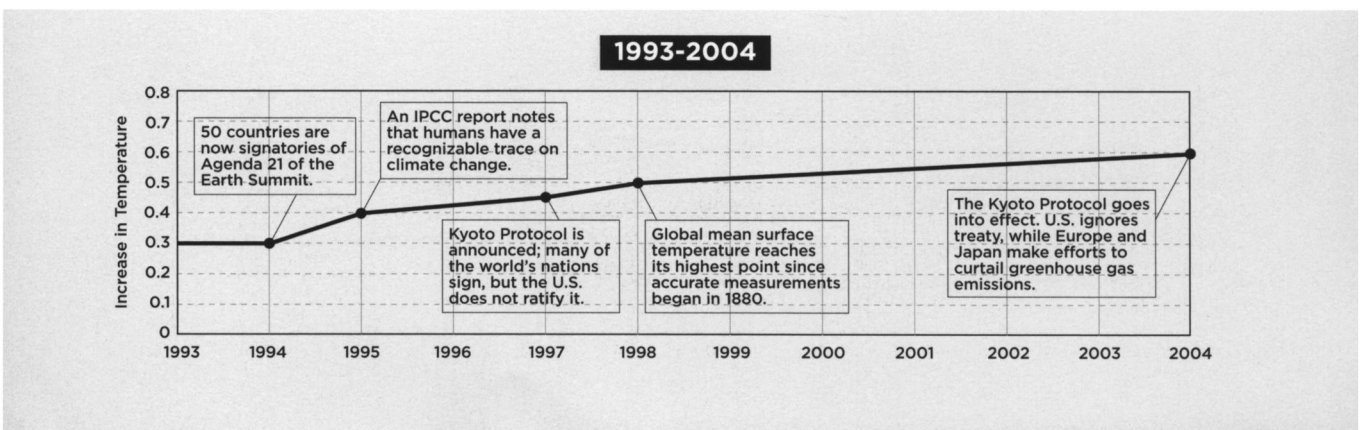
This century, as the world shifts to solar and wind, we are witnessing the localization of the energy economy. Instead of coming from halfway around the world, our energy will be as close as the roofs over our heads. Instead of a few countries producing and controlling most of the world's energy, homeowners everywhere will be in the energy business, producing and managing their own energy supply.

ACTIONS

Government policies are an important component of the energy transition. One basic policy instrument is the feed-in tariff (FIT), which typically guarantees renewable energy producers—from rooftop solar owners to large-scale wind farm operators—grid access and a long-term purchase price for their electricity. Another government measure is to mandate that a certain amount of electricity generation be from renewable sources. Called renewable portfolio standards (RPS) or quotas, these policies are in place at the national level in some two-dozen countries. Tax credits also can support deployment of wind and solar power. Some 37 countries have national production or investment tax credits for renewable energy.

Such pro-renewables policies help level the playing field with artificially cheap fossil fuels that have been subsidized long past their debuts on the energy scene. The energy transition would be supercharged by systematically putting a price on carbon to convey more accurately the true social and environmental costs of burning coal, oil, and natural gas. Done right, pricing carbon sends a powerful market signal and guides decision makers toward more-sustainable choices. Putting a price on carbon can involve implementing a carbon tax, a cap-and-trade system, or a combination of the two. With cap-and-trade programs, regulators set a limit on emissions, and polluters can either reduce their emissions or buy emissions permits on the carbon market. The market sets the price.

A carbon tax, in contrast, is a far simpler instrument—a tax on each ton of carbon dioxide emitted. It could be applied at the wellhead or mine or at the point where



fossil fuels are processed or used. Revenue from a carbon tax can go toward environmental or clean energy programs. Alternatively the carbon tax can be offset by a reduction in taxes on labor or can be returned to consumers directly via a dividend. All but the most profligate energy users would end up better off economically.

Meanwhile, it is generally cheaper to invest in energy efficiency than to build new generating capacity. The International Energy Agency reports that efficiency gains since the 1970s in 11 of its member nations—including Australia, Japan, Germany, and the United States—saved those countries more than $740 billion in avoided energy costs.

There is an enormous potential to reap substantial energy savings in each of the major energy-consuming sectors—lighting, buildings, appliances, industry, and transportation. For example, about 20 percent of global electricity consumption goes to lighting. If all the world's light bulbs were switched from traditional incandescents to compact fluorescents, which use 75 percent less electricity, some 270 coal-fired power plants could shut down. Going further, replacing incandescents with LEDs (light-emitting diodes) can reduce electricity use by up to 90 percent. For perspective, replacing a single 100-watt incandescent bulb with an LED can save enough energy over the bulb's lifetime to drive a Toyota Prius hybrid-electric car from New York to San Francisco.

Aside from shaping the needed policies, governments are also huge energy consumers themselves. Establishing various regulations to require their buildings, vehicle fleets, and electronic purchases to meet certain efficiency standards will save energy as well as taxpayer money.

At the city level, smart urban transport planning, such as increasing the use of car sharing, bike sharing, and walkable communities, will expand not only the use of buses, subways, and commuter rail but also bike lanes, sidewalks, and bike and pedestrian trails.

Individuals themselves can help in the energy transition by the choices they make, from the cars they drive to purchasing the most energy efficient appliances on the market. Even more, they can become politically active, working for needed changes. Saving civilization is not a spectator sport.

We are all stakeholders in this transition. In the broadest sense, everyone who breathes cleaner air, drinks cleaner water, and benefits from a more stable climate will come out on top as the energy transition proceeds. ●