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Tough Love for Renewable Energy

Making Wind and Solar Power Affordable

Jeffrey Ball

OVER THE past decade, governments around the world threw money at renewable power. Private investors followed, hoping to cash in on what looked like an imminent epic shift in the way the world produced electricity. It all seemed intoxicating and revolutionary: a way to boost jobs, temper fossil-fuel prices, and curb global warming, while minting new fortunes in the process.

Much of that enthusiasm has now fizzled. Natural gas prices have plummeted in the United States, the result of technology that has unlocked vast supplies of a fuel that is cleaner than coal. The global recession has nudged global warming far down the political agenda and led cash-strapped countries to yank back renewable-energy subsidies. And some big government bets on renewable power have gone bad, most spectacularly the bet on Solyndra, the California solar-panel maker that received a \$535 million loan guarantee from the U.S. Department of Energy before going bankrupt last fall.

Critics of taxpayer-sponsored investment in renewable energy point to Solyndra as an example of how misguided the push for solar and wind power has become. Indeed, the drive has been sloppy, failing to derive the most bang for the buck. In the United States, the government has schizophrenically ramped up and down support for

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renewable power, confusing investors and inhibiting the technologies' development; it has also structured its subsidies in inefficient ways. In Europe, where support for renewable power has been more sustained, governments have often been too generous, doling out subsidies so juicy they have proved unaffordable. And in China, the new epicenter of the global renewable-power push, a national drive to build up indigenous wind and solar companies has spurred U.S. allegations of trade violations and has done little to curb China's reliance on fossil fuels.

But these challenges don't justify ending the pursuit of renewable power; they justify reforming it. It is time to push harder for renewable power, but to push in a smarter way. Recent advances have made wind and solar power more competitive than ever. Now, for renewable power to reach its potential, the world's approach to it will have to grow up, too. Governments will have to redesign their renewable-power policies to focus ruthlessly on slashing costs. Renewable-power producers will also have to act more strategically, picking the technologies they deploy, and the locations where they place them, in ways that make more economic sense. As renewable power comes of age, it needs some tough love.

This rigor will be crucial, because today's energy challenge is fundamentally harder than those of past decades. Historically, countries have made big energy shifts only when confronted with acute fossil-fuel crises: oil embargoes, debilitating pollution, or wars. That is why in the wake of the 1970s oil shocks, France embraced nuclear power, Denmark ramped up its energy efficiency and then its development of wind power, and Brazil began fueling some of its auto fleet with ethanol. But today's threats—climate change, fluctuating energy prices, and the prospect that other countries might dominate a still-nascent clean-energy industry—are more chronic and less immediate. Thus, they are unlikely to sustain the generous spending that has nurtured renewable energy so far.

SO FRESH AND SO CLEAN

THE FIRST step to adopting a more mature approach to renewable power is to understand how the various technologies work and what challenges they face. Historically, most renewable electricity has come from hydroelectric dams, which now provide about 16 percent of the



world's electricity. Today, the sources growing the fastest and receiving the most investor attention are wind and solar power.

Wind power, which generates about 1.4 percent of the world's electricity, is produced as pinwheel-style turbines spin atop towers that rise hundreds of feet above the ground. Solar power provides an even smaller share of global electricity: just 0.1 percent. Techniques for generating it vary; the most popular uses panels containing wafers of silicon thinner than a fingernail to convert sunlight into electrical current. A few of these photovoltaic panels, as they are known, can be mounted directly on a building's roof, letting the occupants produce at least some of their own power. Or hundreds of panels can be grouped together on the ground in vast arrays that funnel power into the electrical grid—sprawling, centralized power plants of a new sort, some of which have been built in the American Southwest.

Although wind power is more widespread today, solar power is theoretically more attractive. The sun emits a nearly limitless supply of energy, and it does so during the daytime, when people use the most electricity. (Wind tends to blow most strongly at night.) Solar power also is easily distributed—panels can be placed on a streetlight or a soldier's backpack—whereas wind power is mostly a centralized energy source, requiring clumps of turbines to generate sizable amounts of power. But both wind and solar energy offer big advantages over fossil fuels. Wind and sunshine are clean, emitting neither the pollutants that cause smog nor the carbon dioxide that contributes to climate change. They are ubiquitous, providing a domestic energy source even in places with no indigenous fossil fuels. And they are essentially never-ending.

There are huge caveats to this rosy assessment, and they come down mostly to money. In most places, producing electricity from new wind and solar projects is more expensive than making it in new conventional power plants. Wind and solar power are younger technologies, with much work left to be done to wring out cost. The downsides of fossil fuels, notably their geopolitical and environmental risks, are not fully reflected in their market prices. And everything about the modern electrical system is predicated on the use of fossil fuels: the coal mines and gas fields that produce them; the railroads, pipelines, and ships that transport them; and the power plants that burn them. That system has been built up and its costs largely paid down over decades.

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Wind and solar power enjoy no such entrenched infrastructure. The challenge of making and installing the wind turbines and solar panels is just the start. Massive new transmission lines must be built to move large amounts of renewable electricity from the out-of-the-way places where it is generated to the metropolitan areas where it is consumed. This new equipment costs money, and it often stokes opposition from people who are not used to living near industrial-scale energy infrastructure of any sort. Along with other opponents, a group of landowners in Cape Cod, Massachusetts, for instance, has managed to delay the construction of an offshore wind farm that was proposed back in 2001. Even environmental activists often fight large renewable-energy projects, out of concern for local landscapes or animals. Last spring, the Obama administration temporarily halted construction on part of a solar project in the Mojave Desert because of concerns that it would harm endangered tortoises; the government later let the construction resume.

Taking wind and solar power mainstream will also require better ways to get it to consumers when they need it, since the times when wind turbines and solar panels generate the most electricity are not necessarily the times when people use electricity most. Power plants fired by natural gas can be dialed up or down to meet changing electricity demand, but the sun shines and the wind blows only at certain times. One potential solution is to stockpile renewable power—either in large-scale storage equipment, such as massive batteries, or in smaller-scale devices, such as people's plug-in hybrid cars. Other approaches include better technologies to predict gusts and rays and "smart" electrical-transmission grids that could tie together far-flung renewable-power projects. Both could help compensate in one place for doldrums or gray skies somewhere else. Scientists are working to bring down the cost of all these ideas. For now, in some places with dense concentrations of wind turbines, some of the power they could produce is wasted; the turbines are shut off when the wind is blowing so hard that the turbines would produce more power than the grid could handle.

Wind and solar power will not replace fossil fuels anytime soon—not by a long shot. The International Energy Agency projects that by 2035, wind and solar could be producing ten percent of global electricity, up from 1.5 percent now, and that renewables of all sorts could be generating 31 percent of the world's electricity, up from about



19 percent now. But even that expansion would require an increase in subsidies—"support that in some cases," the IEA notes, "cannot be taken for granted in this age of fiscal austerity." Some countries with particularly generous subsidies and high electricity prices have made wind and solar power big enough to matter. Denmark gets 18 percent of its electricity from wind, and Spain gets two percent from the sun—the world's leaders by share, according to the IEA's latest figures. But even that renewable electricity is backed up by fossil-fuel power plants. Last year, fully one-third of the new electricity-generating capacity brought on line in the United States came from wind and solar projects. Even so, given the vastness of the conventional energy system, wind and solar power remained relatively tiny, accounting for just three percent of the electricity the country actually produced. For the foreseeable future, renewable power is likely to supplement, not supplant, conventional energy.

That is why two other shifts will be at least as important as renewable power in addressing the energy problem. One is cleaning up the burning of coal and natural gas, fuels that are cheap, plentiful, and, according to most estimates, likely to continue to generate the lion's share of the world's electricity for a long time. The other is wasting less of the power the world produces from all sources. That means making buildings, appliances, and industrial processes more energy efficient, a complicated but potentially profitable shift that policymakers and entrepreneurs are working on. According to IEA estimates, between now and 2035, improving the efficiency of fossil-fuel power plants would likely cut global carbon emissions more than 1.5 times as much as would rolling out more wind and solar power.

Considering what renewable power is up against, the drive for it might seem a folly. But giving up now would be a mistake. As a result of recent technological improvements, the prospect of renewable power as an economically competitive part of the energy mix is no longer a pipe dream. Wind turbines and solar panels have gotten more efficient and less expensive. According to government and Wall Street analyses, in some particularly windy places, the long-term cost to investors of producing power from new wind projects can now be less than the cost of producing it from new coal- or gas-fired power plants. Solar power remains more expensive than conventional power



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(except in a few sunny places with high power prices, such as Hawaii), but its costs, too, are falling rapidly. Now more than ever, sustained but strategic support could produce blockbuster innovations with the potential to meaningfully change the energy mix.

PAYING FOR POWER

WIND AND solar power would be nowhere near as viable without the subsidies they get from governments. To be sure, all energy sources, including fossil fuels, receive state support. But as the energy world's upstarts, wind and solar power will have to be especially scrappy to gain ground. So far, governments worldwide have tended to promote renewable power in ham-fisted ways, spending money inefficiently.

The modern renewable-power push dates to the 1973 Arab oil embargo. At the time, the West generated much of its power from petroleum, so the embargo threatened not just transportation but also the electricity supply. Many countries decided to seek alternative sources of power. The United States made a particular push into wind. In 1978, it rolled out a subsidy called the investment tax credit. It gave wind-farm developers a tax break for every dollar they spent on wind projects, regardless of how many megawatts those projects produced. The goal was wind turbines, not efficient wind turbines, and the result was predictable: by the early 1990s, many of those subsidized machines were breaking down.

In 1992, the U.S. government enacted a smarter wind subsidy, called the production tax credit. It pegged a wind-farm developer's tax break to the amount of electricity the project produced. Around the same time, states began passing laws requiring power companies to produce a given percentage of their electricity from renewable sources. Today, 29 states, plus Washington, D.C., and Puerto Rico, have such standards on their books.

The combination of the federal tax break and the state renewable-energy mandates transformed wind power from an inventor's dalliance into an investment banker's dream. Wind power became a nationwide industry with guaranteed buyers and an attractive rate of return. The tax break did not directly help the mom-and-pop wind developers; their tax liabilities were too small to exploit the full value of the credit.



But it appealed to financial institutions, which, by buying into the developers' wind projects, could apply the federal tax break to their own bottom lines.

Propelled by the tax break, wind turbines have spread across the United States, particularly in the so-called wind alley running from North Dakota down to Texas. But the tax-break strategy has made the campaign for renewable power more expensive than it might have been. Whereas tax breaks for the fossil-fuel industry are long term, those for wind power have come in only one- or two-year bursts, a sign that the country has viewed renewable power as an afterthought. The consequence has been an inefficient, boom-bust cycle of wind-farm development. Companies race to get wind projects built before the current subsidy expires, often installing more turbines than the grid can handle. In some parts of windswept Texas, so many turbines are competing to shove power into the transmission grid that wind farms have had to hold back on windy days.

The tax break, moreover, is not just paying for the construction of wind turbines; it is also lining bankers' pockets. The financial institutions investing in wind farms in exchange for the tax break exact a profit. That's capitalism, of course, and energy is hardly the only industry in the United States that relies on financing from tax breaks. Yet according to some estimates, about 30 percent of the value of renewable-power tax credits ends up benefiting financiers rather than funding renewable-energy production.

The United States is not alone in spending inefficiently on renewable power. Some western European countries have spent even more money than the United States for each unit of renewable power that they have produced. Their solar-panel push, in particular, illustrates how poorly designed subsidies can stymie the development of renewable power.

Germany, hardly a sunny place, was Europe's first big solar power enthusiast. It began promoting the sector in earnest in the early 1990s, largely in response to two crises: the 1986 Chernobyl nuclear accident, which soured many Germans on nuclear power as a fossil-fuel alternative, and the 1990 reunification of poor East Germany and rich West Germany, which launched a national push for job-creation programs, such as solar-industry subsidies. By the late 1990s, Germany had rolled out a subsidy more generous than the United States'



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renewable-power tax credit. Called a feed-in tariff, it lets solar-project developers sell power to the German electrical grid at a premium price guaranteed by the government. By the middle years of the last decade, the country had become the world's biggest solar market. Investors, from big banks to small entrepreneurs, profited handsomely.

Other countries in Europe eyed Germany's solar stampede with envy. By 2007, with the global economy roaring and popular concern about climate change cresting, Spain enacted its own solar feed-in tariff, which guaranteed a similarly high electricity price. Sure enough, solar developers raced to build projects in Spain (a sunnier place than Germany), and the Spanish government found itself paying out more in subsidies than it had anticipated. Then, the global recession hit, and Spain decided its solar power extravaganza was a luxury it could no longer afford.

Several European countries are now dialing back their subsidies. Germany and Italy have slashed the guaranteed prices they offer new solar projects. The Czech Republic and Spain are going further, retroactively pulling back subsidies they already gave to existing projects. That retrenchment has slammed the brakes on the development of solar power in Europe. And it has had a ripple effect worldwide, eroding the stock prices of solar-panel makers from California to China that had ramped up their production to supply the European market.

CHINA'S RENEWABLES PUSH

AS WESTERN governments have scaled back their support for renewable power, China has been pushing full steam ahead. Probably more than any other country today, China feels an imperative to develop renewable power—to boost jobs and exports, to consume cash and counter inflationary pressure, to ease the country's rising fossil-fuel demand, and to help clean up its polluted air. In China, the global leader, renewable-energy investment, excluding spending on research and development, surged to about \$50 billion in 2010, according to Bloomberg New Energy Finance. Next came Germany, at \$41 billion, and then the United States, at about \$30 billion.

The scale of China's push, although massive, should not be overstated. China still generates about 80 percent of its electricity from coal. It is building dozens of new coal-fired power plants each year



and is laying a massive network of pipelines to import more natural gas. According to IEA figures, wind and solar in China, as worldwide, together provided about 1.5 percent of electricity in 2009, and that share might rise to ten percent by 2035.

China's push has produced some of the biggest wind-turbine makers in the world. Bigger, however, does not necessarily mean more efficient. China's early wind power subsidies, like those in the United States, rewarded installing wind turbines, not producing wind power. That subsidy structure, combined at the time with rules requiring that

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for renewable power
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a certain percentage of the material for each turbine to be produced domestically, gave Chinese wind power companies a powerful leg up on foreign competitors. (In the past two years, the Chinese company Sinovel displaced General Electric as the world's second-biggest wind-turbine manufacturer by market share, behind Denmark's Vestas.) But the Chinese system also led to overkill.

In the region of Inner Mongolia, Chinese companies installed more turbines than the grid could handle, and about 25 percent of those turbines have yet to be connected to transmission lines. China is racing to beef up the grid, but for now, the excess turbines amount to very tall white elephants.

China's solar power industry has grown even faster than its wind power sector. More than any other factor, the torrid expansion of low-cost Chinese manufacturing to feed the heavily subsidized European solar power market is what has slashed the price of silicon, and of solar panels, over the past two years. Indirectly, the Chinese solar power juggernaut killed Solyndra. The company's product, a novel system of photovoltaic tubes that used less silicon than traditional flat panels, was not competitive in a world where silicon was suddenly cheap. Last fall, a handful of Western solar-panel makers filed a trade complaint against their Chinese counterparts, alleging that China's solar power subsidies violate trade laws, allowing Chinese companies to dump solar panels on the U.S. market at prices below the cost of production. Beijing has denied the charge, saying in return that it will investigate the fairness of U.S. renewable-power subsidies.



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U.S. officials are expected to issue a final decision later this year about whether to impose unfair-trade duties on imported Chinese panels. But beyond this legal dispute lies a larger lesson: if the goal of the renewable-power push is a cleaner, more diversified power supply, then low-cost solar equipment, from China or anywhere else, is a good thing. That, in turn, suggests a bedrock principle for a smart U.S. renewable-power strategy: exploit globalization rather than fight it.

POWER PLAY

A SENSIBLE PUSH for renewable power in the United States would start with a broader effort to make the nation's energy system cleaner and more secure. The Obama administration's stimulus plan sought to compensate for the lack of a comprehensive energy strategy by picking a portfolio of short-term winners, such as Solyndra. Even if some of those bets pay off—and many still might—those sorts of wagers are insufficient. A better approach would be to set a broad direction for the energy system and then let that newly defined market determine which technologies and companies rise to the top. One worthwhile move would be for the government to boost funding for advanced energy research, just as it raised funding for space research when it wanted to send a man to the moon and ratcheted up spending on defense research when it wanted to win the Cold War. Another would be to aggressively prioritize improvements in energy efficiency, because it makes no sense to pay for wind and solar power that then will be frittered away in inefficient buildings and machines. Yet another reasonable step would be to slap a price on carbon emissions, although its effectiveness would depend on the details. Many corporations and investors have been advocating a carbon price, but they disagree mightily over how to structure it. And the structure would determine how the policy affected U.S. consumers, various industries, and, indeed, the planet.

An essential part of any shift to a cleaner and more secure energy system would be rationalizing the patchwork of conflicting energy subsidies that has been stitched together over decades. According to the IEA, renewable energy worldwide receives less money in annual subsidies than fossil fuels do. Renewable energy, including fuels for transportation and electricity, got \$66 billion in subsidies globally in



2010, the IEA says, a fraction of just one subset of subsidies for fossil fuels: the \$409 billion to defray their cost to consumers. But the flip side, some studies conclude, is that renewable sources in their early years have been more heavily subsidized than fossil fuels for every unit of electricity they actually produce. An apples-to-apples comparison of energy subsidies, and an open debate about which ones most effectively promote the kind of energy system the United States wants, should appeal to honest partisans of all stripes.

Once the United States sets out a sensible overall energy approach, it should tailor its wind and solar strategies to play to the country's strengths. That means focusing on the higher end of the market, developing next-generation technologies and business models that have the potential to make wind and solar power truly cost competitive with fossil fuels. Despite much hype about the potential for "green jobs," the United States should be selective about the kinds of green jobs it pursues: not run-of-the-mill assembly-line positions that can be easily outsourced, but jobs in engineering, high-value manufacturing, and renewable-power installation, financing, and servicing. Studies of the solar power industry suggest that the bulk of the jobs are not in making the panels. They lie upstream, in producing the raw materials and the machinery that are used to make the panels, and downstream, in installing and servicing the panels. Indeed, much of the machinery used in Chinese solar-panel factories today is made in America. Similarly, some of the most innovative business models for deploying solar panels on rooftops—such as that in which companies install the equipment for property owners at no up-front cost and then charge the consumers a favorable electricity price—come from U.S. firms.

To the extent that the United States installs today's renewable-energy equipment, it should relentlessly squeeze out cost. One way to do that would be to auction renewable-power subsidies to companies that agree to produce the largest amount of electricity at the lowest price. Another would be to expand the box of tools used to finance wind and solar power—moving beyond today's tax credits to instruments that broaden the pool of investors and thus lower the cost of capital. A third would be to clear away the thicket of regulatory barriers that impede innovation and distort the renewable-energy market.

In the United States, regulators at the federal, state, and local levels



should simplify the permit process for wind and solar projects, including the installation of transmission lines, even in the face of opposition from landowners and environmentalists. Some studies suggest that upward of 20 percent of the cost of installing solar-panel systems in the United States comes not from the panels themselves but from administrative red tape. Balancing the desire for renewable power with property rights and local environmental concerns is crucial. But prioritizing certain areas of the country for renewable-energy development, and then streamlining the process of breaking ground on projects, would accelerate those ventures that make the most economic sense.

Globally, policymakers should resist the urge to slap tariffs and local-content requirements on renewable-energy equipment. All countries, including China, should be forced to comply with international trade rules. If they play fair, however, they should be allowed to play hard. In renewable power as in other industries, tough competition will produce the most cost-effective products. The most enduring way for the United States to snag a profitable piece of the global renewable-power market is to do certain things better than other countries, not to try to deny American consumers commodities that other countries can make legally at a lower cost.

If the United States followed this strategic approach, far from ceding its ambitions as a global renewable-power leader, it would harness its strengths as a technological innovator to make wind and solar power more competitive as a complement to coal and natural gas. On the one hand, such a strategy would recognize that renewable power has benefits over fossil fuels that, in this early stage of its development, are worth paying extra for. On the other hand, it would seek to ensure that subsidies for renewable power, as well as subsidies for conventional energy, gradually shrink and eventually even stop.

The energy debate has been too ideological for too long. Wind and solar power will never reach the scale necessary to make a difference to national security or the environment unless they can be produced economically. That is why the United States needs to be clear about its goals. The objective is not wind turbines or solar panels. It is an affordable, convenient, secure, and sustainable stream of electrons. Wind and solar power may well provide much of that electricity, but only if they can be produced in a way that doesn't break the bank. 🌍

