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David G. Victor and Kassia Yanosek

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The Crisis in Clean Energy

Stark Realities of the Renewables Craze

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AFTER YEARS of staggering growth, the clean-energy industry is headed for a crisis. In most of the Western countries leading the industry, the public subsidies that have propelled it to 25 percent annual growth rates in recent years have now become politically unsustainable. Temporary government stimulus programs—which in 2010 supplied one-fifth of the record investment in clean energy worldwide—have merely delayed the bad news. Last year, after 20 years of growth, the number of new wind turbine installations dropped for the first time; in the United States, the figure fell by as much as half. The market value of leading clean-energy equipment manufacturing companies has plummeted and is poised to decline further as government support for the industry erodes.

The coming crisis could make some of the toughest foreign policy challenges facing the United States—from energy insecurity to the trade deficit to global warming—even more difficult to resolve. The revolution in clean energy was supposed to help fix these problems while also creating green jobs that would power the economic recovery. Some niches in clean energy will still be profitable, such as residential rooftop solar installations and biofuel made from Brazilian sugar cane,

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The Crisis in Clean Energy

which is already competitive with oil. But overall, the picture is grim. This is true not only for the United States but also for the rest of the world, because the market for clean-energy technologies is global.

Whether this shakeout will strengthen or weaken the clean-energy industry will depend on how policymakers, notably in the United States, prepare for it. The root cause of today's troubles is a boom-and-bust cycle of policies that have encouraged investors to flock to clean-energy projects that are quick and easy to build rather than invest in more innovative technologies that could stand a better chance of competing with conventional energy sources over the long haul. Indeed, nearly seven-eighths of all clean-energy investment worldwide now goes to deploying existing technologies, most of which are not competitive without the help of government subsidies. Only a tiny share of the investment focuses on innovation.

Solutions must start with more consistent long-term policies that depend less on subsidies and thus are less vulnerable to cutbacks in these times of fiscal restraint. Rather than rely on such "push" incentives, a new strategy must favor policies that "pull" new clean-energy technologies into the market, such as rules requiring that more energy gradually be produced from clean sources. It should shift scarce public funds to the development and testing of more radical innovations in biofuels and electric power, including innovations in the energy storage that is essential to deal with the intermittence of solar and wind power. It should also do more to encourage innovation in and greater access to markets in emerging countries, such as China, where energy demand is growing. An open and competitive global clean-energy market, underpinned by an innovation-driven clean-energy strategy, could yield a true energy revolution.

ANATOMY OF A CRISIS

THE CLEAN-ENERGY business, like many infant industries, depends on government support. Governments have many ways of affecting innovation, but in the energy industry, the most important ones focus on overcoming two obstacles. The first obstacle is the technology gap, or the short supply of commercially plausible technologies. The U.S. government and some private companies have helped fill this gap

by funding basic research and by backing some of its most promising projects, such as the invention of organisms that can create biofuels. The second obstacle is the commercialization gap. New technologies often require massive investments in commercial-scale testing before the private sector can fully fund them on its own.

Plugging the commercialization gap is far trickier than plugging the technology gap because the costs are greater and the best policies require government agencies to work alongside private actors without undermining market competition—a delicate balancing act. And it is in this area that the clean-energy industry is most in trouble today. Many innovative ideas bubble up in laboratories and even attract early stage venture capital funding. But these ideas often die because when it comes to testing and deployment, governments throughout the world overwhelmingly support the least risky concepts, which often are the least innovative. Examples include biofuels derived from food crops and onshore wind farms—technologies that absorb the bulk of clean-energy subsidies, steering investors toward existing technologies rather than innovative ones. This pattern has unwittingly created an industry that is unable to scale up and compete with existing energy sources without government help. In the United States, tax credits and depreciation benefits account for more than half the after-tax returns of conventional wind farms, for instance. Investors in solar energy projects depend on U.S. government subsidies for at least two-thirds of their returns. And the U.S. government lavishes on producers of corn-derived ethanol between \$1 and \$1.50 per gallon of ethanol produced—just about the costs of production—despite the fact that almost no one considers corn-derived ethanol to be an economically viable fuel that can protect the environment or reduce dependence on oil.

In the United States, most clean-energy subsidies come from the federal government, which makes them especially volatile. Every few years, key federal subsidies for most sources of clean energy expire. Investment freezes until, usually in the final hours of budget negotiations, Congress finds the money to renew the incentives—and investors rush in again. As a result, most investors favor low-risk conventional clean-energy technologies that can be built quickly, before the next bust. Historically, most incentives have come as tax

credits. During the recent financial crisis, when investors (mainly large banks) lost much of their taxable earnings, investment plummeted and sent the clean-energy market into a tailspin. An emergency scheme called Section 1603, adopted as part of the government's fiscal stimulus plan in early 2009, offered one-year direct cash grants. These were structured to cover a percentage of the costs of shovel-ready projects, which gave beneficiaries few incentives to cut costs so as to make these technologies more competitive for the long haul. Section 1603 pumped over \$2.7 billion into the U.S. wind, geothermal, and solar markets in 2010 alone. With hard cash proving more attractive than tax credits, the industry successfully lobbied to extend the scheme through the end of 2011.

In parallel with these federal incentives, many U.S. states offer subsidies to clean-energy producers and impose mandates that force electric companies to buy from them. Twenty-nine U.S. states and the District of Columbia have adopted binding renewables portfolio standards, which require that a minimum fraction of the electricity they produce come from renewable sources. (The exact fraction varies by state, as do the rules for what qualifies as "renewable.") Because the states and the federal government rarely work in tandem, the clean-energy market in the United States suffers from a patchwork of varied and volatile policies. This system has unwittingly given investors good reasons to spend largely on conventional renewable-energy technologies that can be developed quickly rather than on innovations that could, once developed at scale, compete with traditional energy sources.

The opportunities for clean energy in the United States depend on the global market, where there is more bad news. Notably, in Europe, long a reliable backer of clean energy, a similar crisis is unfolding. Barely a month passes without a new European country, seized by fiscal austerity, announcing cutbacks in subsidies. The German government cut solar subsidies in 2010 and is expected to do so again in 2011; Italy, one of Europe's biggest clean-energy markets, has just

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capped subsidies for solar energy; and the Czech Republic and Spain are retroactively cutting back on the prices they had said they would pay for solar energy. These cutbacks mainly reflect an increasing aversion to subsidies, but they also reflect the fact that as these technologies decline in cost, they no longer require subsidies as large as before. Erratic government support is one major reason why total global investment in renewable energy plunged by one-third between the last quarter of 2010 and the first quarter of this year.

In China, government support has been much steadier, which is why China is now the world's largest spender on clean energy and led the world in deploying conventional wind technologies last year. But there, the infrastructure needed to make clean energy useful has not yet caught up to investment. More than half of China's wind farms go unused because they are not connected to the grid. Many of China's renewable-energy projects reflect the desire of local and provincial governments to create jobs rather than produce commercially viable sources of energy.

The global renewable-energy industry is already feeling the effects of waning support. The WilderHill New Energy Global Innovation Index, which tracks the performance of 100 clean-energy stocks worldwide, fell by 14 percent in 2010, underperforming the S&P 500 by more than 20 percent. Equipment manufacturers, such as solar cell producers and turbine manufacturers, have taken the biggest hit so far. Last year, the shares of companies plummeted due to soft demand in Western markets and increased competition from Chinese companies. (One silver lining is that oversupply will lower prices for consumers, a trend already evident in the market for solar cells worldwide.) With clean energy suffering from long time horizons, high capital intensity, and a heavy dependence on fickle public policies, some Silicon Valley venture firms are scaling back or even canceling their "clean tech" investment arms.

To be sure, some pockets of robust growth remain, especially where governments have not wavered in their support and found more palatable ways of hiding the full cost of subsidies—for example, by passing the costs directly on to consumers through taxes in electric power bills. These pockets include offshore wind in northern Europe, onshore wind in China, and residential rooftop solar energy in the

The Crisis in Clean Energy

United States (a darling of policymakers in California, Florida, and sunny New Jersey). But a true clean-energy revolution cannot be built on just these niches.

TALKING ABOUT A REVOLUTION

THE GROWING crisis in the clean-energy industry offers an opportunity for the U.S. government to reconsider its strategy. Few of the clean-energy technologies being widely deployed today are economically viable without significant government support. (One exception is biofuel made from Brazilian sugar cane—which helps explain why the U.S. corn-based biofuel industry has mobilized against Brazilian biofuel imports to the United States.) None is likely to be commercialized to the extent needed to make a dent in energy insecurity or global warming.

Making real progress will require three shifts in approach, all designed to increase innovation and competition in the clean-energy market and thus to lower the costs of new supplies. First, the U.S. government should adopt more “pull” policies, instead of expensive subsidies that “push” technologies into the market. The best approach would be to impose a cap or tax on global-warming pollution, but for now, those efforts are dead in Congress. Second best would be to set a federal clean-energy standard. Making such a standard work will require rethinking what counts as clean energy. Most policy wrongly focuses on a narrow range of popular technologies, especially renewables such as wind and solar energy. Competition could be increased by allowing into the mix other clean sources of energy, such as safe nuclear power and newfangled low-pollution coal plants, while also encouraging energy efficiency. In the wake of the earthquake and the Fukushima nuclear plant crisis in Japan early this year, the case for nuclear power will require special attention. But the fundamental fact is that nuclear power remains one of the only large-scale sources of electricity that do not cause global warming.

A federal standard should also be designed to encourage a shift away from mature renewable-energy technologies and toward the next generation of more innovative technologies that could ultimately scale up without the help of subsidies. Broadening the definition of clean

energy and forcing technologies to compete on performance would make for a more competitive industry overall. These measures would also put the industry on firmer political footing by emancipating it from subsidies that are prone to disappear when they get too big to escape the notice of budget hawks. And they would broaden political support for moving away from more polluting and less secure conventional forms of energy, raising the odds that a clean-energy revolution might eventually succeed.

Second, the U.S. government must focus the scarce fiscal resources it devotes to clean energy on smarter subsidies that can close the funding gaps in technology and commercialization. (Pull strategies cannot do all the work alone; the push effect of subsidies must be shifted from mature technologies to a wider array of earlier-stage technologies that need government funding.) Washington can address the technology gap by backing more fundamental research in universities and government labs across a wide array of topics. More than half of all research-and-development money in clean energy comes from the government—proof that private investors are unlikely to fill this gap on their own. (Keeping political support for this funding is particularly important in this era of tight government budgets.) It can also support early stage technologies that private investors will not adequately fund, expanding mechanisms such as the U.S. Department of Energy's new Advanced Research Project Agency—Energy (ARPA-E). Such programs have been controversial with analysts who fear that the government might back the wrong horse. ARPA-E reduces this danger by funding a variety of competing technologies while leaving the private sector to pick the winners. Indeed, ARPA-E was modeled on effective schemes at the Pentagon that back risky, novel technologies. Secret budgets at the Department of Defense have made it possible for bureaucrats there to take risks that are harder to sustain in, say, the Department of Energy, where budgets are more transparent and less secure. Adding a layer of insulation between the Department of Energy's main budget and ARPA-E would give the agency freer rein to invest in only the most innovative technologies that private investors are less willing to support. Improving ARPA-E will require steady funds—its budget has been on the chopping block—and allowing

it to forge long-term partnerships with private firms, which are important for pilot testing and deployments.

To help close the commercialization gap, the U.S. government should help lower the financial risks of developing new technologies. It can do so in a variety of ways, including by improving and expanding loan guarantee programs for innovative technologies and working with state regulators to allow electric utilities to recover more reliably the money they spend on clean-energy innovation through customers' bills. For example, loan guarantees have already proved essential to promising large-scale solar power projects and to firms that test new technologies designed to burn coal much more cleanly. The existing programs have been fraught with administrative difficulties, however, partly because they formally sit within the Department of Energy and must comply with budget rules that discourage the risk taking that is essential to innovation. Making these programs more effective will require putting them at arm's length from the bureaucracy. A proposal for a new independent federal financing entity, the Clean Energy Deployment Administration, would do just this by providing loan guarantees and other financial tools. But CEDA has not been approved or funded. The one-time \$10 billion capitalization needed for this program has made budget hawks balk, even though extending Section 1603 through 2011 will cost at least as much. Creating CEDA, which is long overdue, would be one way of allowing the government to provide more nimble support for testing and deploying technologies, such as enhanced geothermal energy and next-generation nuclear energy, that the private sector cannot, or will not, invest in on its own.

Third, the U.S. government must do more to engage with emerging markets, which is where most of the growth in energy consumption and investment in infrastructure will occur in the future. Doing so will require, among other things, launching cross-border partnerships that include both governments and firms and creating larger markets for clean energy. The U.S. government should encourage U.S. firms to spend funds from government-sponsored clean-energy research on joint projects with foreign companies. A handful of private and government U.S.-Chinese innovation initiatives have already been set up with the goal of funding joint research and the testing of clean-

energy technologies. But these partnerships remain small, and they are prone to focus on topics, such as intellectual property rights, that arouse passions but are not the main obstacles to innovation today. China will be a particularly important partner because advanced nuclear energy, clean-coal projects, and other pivotal innovations in clean energy are likely to be much cheaper to build and easier to test there than elsewhere. To encourage Beijing's cooperation, the U.S. government should also ensure that the market for clean energy stays open and is competitive. Although the Doha Round of trade talks has limped along for nearly a decade without any viable final agreement in sight, a few clean-energy powerhouses—Brazil, China, the European Union, India, Japan, and the United States—could strike a special deal focused on energy, an area (unlike agriculture) in which a bargain should be relatively easy to design. Ultimately, open global markets are the best platform for U.S. innovation to create jobs and solve global problems, such as climate change and energy insecurity.

CRISIS AND OPPORTUNITY

BIG CHANGES in the energy industry do not happen overnight. The bold goals of energy independence and of radically shifting to renewable energy may be attractive to politicians who prize what is popular over what actually works in the long run. Short-term motivations have created boom-bust patterns that have hurt the clean-energy industry; they have produced business models that depend too much on subsidies and on technologies that cannot compete at scale with conventional energy.

The crisis in the clean-energy sector is here. It presents an opportunity for the U.S. government to devise smarter, more sustainable policies—policies that put a higher priority on innovating today with an eye toward tomorrow. Such a strategy will be politically difficult to carry out in these times of shrinking government budgets. But these are also the times for making tough choices. 🌍