CARBON DIOXIDE EMISSIONS ARE ACCELERATING.

Trade imbalances are accelerating. We may soon be sending half a trillion dollars a year abroad for energy. Is this sustainable? Can we do anything about this incrementally, or do we need a grand plan — an emergency response? By some measures, it might even be too late.

However, we are much closer to a feasible solar economy than people realize. Simply capturing the value implicit in a 60-year lifetime would allow solar firm peaking power to be directly cost competitive with natural gas by 2015. This means we can soon reach the tipping point at which we can reduce both energy dependence and CO_2 emissions without societal cost. This gives us an entry into the solar economy at just the price of priming the pump. Once we have large, successful systems, and the regulatory climate changes to support solar, the solar economy will become self-sustaining.

We can solve global warming and energy shortages by harnessing sunlight in the Southwest. The solar resource is up to the task. Modern solar technology has two credible, economical options — photovoltaics and concentrating solar power. There are practical means of storing the solar electricity to make it firm and dispatchable. And if we move to mostly electric transportation through hybrid vehicles, solar electric can do it all.

A secondary but important aspect of our plan is to max out most other nonsolar renewables like wind, geothermal, geothermal heat pumps and biomass. We also expect to max out distributed and rooftop photovoltaics.

Local and national policy makers, utility executives and regulators will play a crucial part. Our plan needs their full-fledged participation. We think this is likely, based on the attractive value of the shift to solar and the important role that decision makers will have in this evolution.

There is plenty of sunlight in the world — about 40 minutes is equivalent to all the energy humanity uses. There is plenty of sunlight in the Southwest, enough to meet a tripling of energy applications during the century to about 30,000 terawatt-hours, which is 3.4 terawatts of production capacity at 100 percent annual capacity factor. And the sunny weather in the Southwest is dependable enough to ensure continuity of supply, with the right storage capabilities.

Based on a traditional 30-year analysis period, intermittent solar on a utility scale without subsidies is today about 15 cents a kilowatt-hour for the lowest-priced systems and similar for concentrating solar power without storage. To transform this intermittent electricity feedstock into firm power, we need storage.

Solar systems have exceptionally long, useful lives. The simple, nontracking photovoltaic system is especially rugged and long lasting, with only a predictable annual degradation of about 0.5 percent per year for most technologies. These systems could last 60 years. Conventional plants also are often refurbished after 30 years and are able to continue. The major difference is that the costs associated with conventional plants are mostly fuel costs, so lasting 60 years doesn't save much. But with solar, especially nontracking photovoltaics, there is no fuel cost.

SOLAR ELECTRIC INCENTIVES

Solar is closer to being economical than we realized. But to jump-start its adoption and to wring out the last few cents necessary to make it directly cost-competitive, we see an opportunity to incentivize solar installations in the Southwest. Existing solar companies are already projecting a 50 percent reduction in the cost of intermittent solar electricity.

HERE COMES THE SUN

SOUTHWEST SOLAR POWERS AMERICA

BY KEN ZWEIBEL, JAMES MASON AND VASILIS FTHENAKIS

ILLUSTRATION BY BRYAN PETERSON

EDITOR'S NOTE *"A Grand Plan for Solar Energy" graced the cover of the January issue of* Scientific American *magazine. The subhead: "By 2050, it could free the U.S. from foreign oil and slash greenhouse emissions."* EnergyBiz *contacted the authors of the piece and invited them to submit additional thoughts about their ideas that would be relevant to our readers. Their submission follows.*

Tucson Electric Power has ample land available for future solar power expansions and caverns suitable for compressed air storage near its existing facility in Springerville, Ariz.

PHOTO COURTESY OF TUCSON ELECTRIC POWER

This would be the result of economies of scale and continued technology improvement.

How do we propose to incentivize this progress? Europeans have shown the way via a production-related payment to solar electric generators. They pay a fixed price for 20 years that is sufficient to induce solar installations. The utility pays the wholesale price at the going rate; the public pays the rest. An electricity production incentive such as the feed-in tariff builds in accountability of solar manufacturers to solar power plant owners. We do not have a specific regimen yet. How to best structure a 60-year financial package is an open question.

Policy makers will play a crucial role in facilitating access to land in the Southwest for solar arrays and for radiating spokes of long-distance high-voltage direct current transmission lines from there to other regions. Developing national, integrated HVDC electricity transmission is critical if the United States is to fully exploit its massive Southwest solar resource. These are controversial needs, but we believe that solar will make a strong case. Indeed, we will design our systems to leave the least-lasting footprint on the desert.

Turning to transportation, what role can solar play? Is the transition to an 80 percent electric transportation sector even technically feasible? We believe the pressure to use electricity will be significant, since oil prices may continue to rise and our imbalance of payments for foreign oil may be economically and politically unsustainable. We also believe the car companies see the handwriting on the wall.

How will the liquid fuels portion be met? We don't know, but speculate that fossil fuels, biomass, and eventually hydrogen from biomass and solar-electric water splitting will each play a role. Thankfully, with 80 percent of transportation coming from electricity, this won't be anywhere near as challenging as meeting the need with biofuels alone.

STAKEHOLDER ACTIONS

Developing the potential of solar requires the help of utilities, car makers, environmentalists, policy gurus, private investors, the public and scientists. We need their collective foresight to address climate change and energy bottlenecks right now.

We are far from the kind of political critical mass that moves solar to center stage. Right now, people are only beginning to accept global warming as an issue and possible energy shortages as more than an irritant. Few make any connection between electricity and transportation. Few know that solar and renewables can meet the need, and do so economically. We need the participation of the policy and energy communities in a high-energy debate about solar and its feasibility.

PROPOSAL

Solar would provide 69 percent of electricity and 35 percent of U.S. energy by 2050

REQUIREMENTS

100,000-500,000 miles of high-voltage direct current transmission grid tying the Southwest with the entire United States

2,940 gigawatts of photovoltaic generation

558 gigawatts of concentrated solar power

535 billion cubic feet of compressed air storage

Are there other grand plans? Yes. We can consider a nuclear plan with 5,000 nuclear power plants to meet the same electricity demand. Or we could pump underground an unheard of amount of CO_2 from coal. Each is fraught with challenges. If solar could work economically, most people would choose it. But most people don't even know there is a solar alternative. They have bought the view that solar is "boutique power," not the biggest resource on the planet. And they don't know that solar in the desert is close to cost-competitive today.

Ken Zweibel is president of Primestar Solar in Golden Colo., James Mason is director of the Solar Energy Campaign and the Hydrogen Research Institute, and Vasilis Fthenakis is head of the Photovoltaic Environmental Research center at Brookhaven National Laboratory.

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