IT'S DOABLE

BUILDING TRANSMISSION FOR SOLAR

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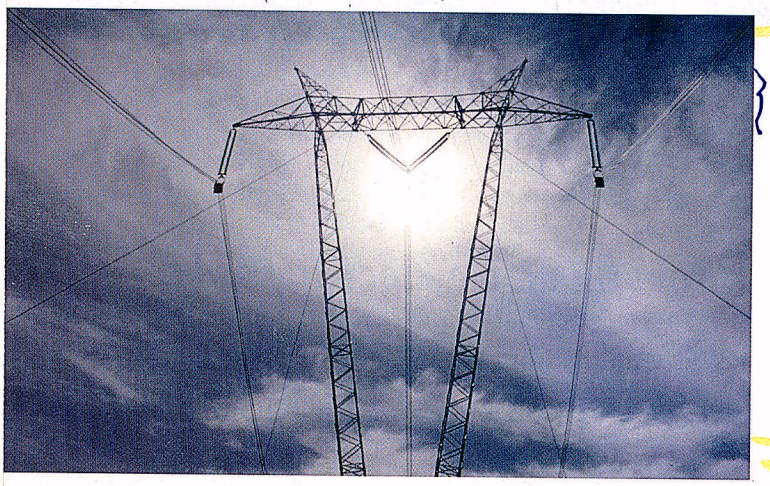
THE AUTHORS OF THE *SCIENTIFIC*

American article on solar energy spend relatively little time discussing the implications of building the 100,000 to as much as 500,000, miles of high-voltage direct-current (HVDC) transmission lines. The choice of HVDC is appropriate to move the volumes of power generated over the long distances involved. Construction of this many miles of HVDC transmission will be a challenge, but fortunately it is doable.

Using existing technology, and current costs per unit of transmission construction, the cost of constructing the necessary HVDC lines to move the volumes of solar power generated could top $1.3 trillion. Using reasonable estimates of the total energy produced suggests that the



cost to transmit this power would be in the range of $20 per megawatt-hour, or three to four times more than the transmission cost component of typical utility systems. What is needed is a dramatic improvement in technology and in unit cost. Fortunately, the path is already clear on how this can be achieved. One of the major manufacturers of HVDC equipment has already secured a contract to build an HVDC line in China rated 5 gigawatts utilizing 800 kilovolt technology. Further advances are sure to come.

The larger problem, however, is less the cost of transmission than the siting of it. Even if today's maximum capacity ...er HVDC line were to double, it suggests that as many as ... individual exit/collector lines would have to emanate from ...r-producing regions of the desert Southwest. Siting ...lose to this number of overhead lines is effectively ...espite the remoteness and unpopulated nature ...developed for solar generation. In order ...cts and myriad other land use conflicts, the answer must be to place the vast majority of the exit/collector lines underground. As you move further away from the solar generation areas, overhead transmission becomes more of an option, as you then are able to repower many existing transmission rights of way to accommodate the HVDC construction.

Fortunately, progress in underground HVDC is evolving rapidly, and further advances in technology and cost are expected. We have had experience scoping an HVDC project utilizing underground cable technology. HVDC has the attractive feature of being "underground-able" for long distances, unlike high-voltage alternating-current lines. Undergrounding allows exceptionally effective use of highway and railroad rights of way. In addition to continuing advances in cable design, there is the need to develop cost-effective methods of installing the cable. HVDC cable is large – 6 inches in diameter in some cases – and heavy – 15 to 20 pounds per foot – and effective means of transporting the masses of material involved will also need further development. Given the long time-span of the grand solar plan's construction, we believe that the advances in cable design, installation, and lower unit cost will occur. Given the increasing costs of conventional overhead construction, advances in HVDC underground technology may reduce, and ultimately eliminate, the cost advantage of overhead HVDC construction.

As the authors posit for the solar generation itself, the development of a domestic fabrication ability for the HVDC equipment and cable can provide tens of thousands of jobs, and the installation, maintenance and operation of the equipment, many thousands more. At this time, the United States does not manufacture any of the world's HVDC terminal equipment. There are no reasons it cannot do so. It is even more important that the manufacture of the necessary HVDC underground cable be done domestically. As noted, this cable is large and heavy. A 100-mile stretch of HVDC underground line, rated at 6 gigawatts, is going to require four cables, weighing a total of about 60 pounds per linear foot, or almost 16,000 tons, and we would need to install several thousand times this amount to accomplish the grand solar plan. Domestic production of this quantity of cable would substantially lower installed costs compared with the current industry option of having this cable manufactured overseas.

For the grand solar plan to become a reality, attention to the technological advances needed in the area of underground HVDC must occur simultaneously with the advances in solar power generation. Our belief is that these advances can, and should, occur.

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