Cost of Decarbonizing

THE POWER TO REDUCE CO_2 EMISSIONS

BY REVIS JAMES

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THE LARGE-SCALE CO_2 REDUCTIONS envisioned to stabilize, and ultimately reverse, global atmospheric CO_2 concentrations present major technical, economic, regulatory and policy challenges. Reconciling these challenges with continued growth in energy demand highlights the need for a diverse, economy-wide approach.

The Electric Power Research Institute's Energy Technology Assessment Center conducted a three-part analysis to assess the technical feasibility of substantial CO_2 emissions reductions from the U.S. electricity sector; identify technology development pathways and associated research, development and demonstration (RD&D) funding needed to achieve this potential; and evaluate the economic impact of realizing emissions reduction targets.

The electric sector should focus on a technology-based strategy for reducing its greenhouse gas emissions. A technology-based strategy is sustainable, minimizes costs to the U.S. economy, and creates opportunities for other industries and the transportation sectors to reduce emissions through increased electrification.

A diverse portfolio of advanced technologies will be required. No single technological "silver bullet" will suffice. Rather, a full portfolio is needed that includes efficiency, renewable energy resources, nuclear, coal with carbon capture and sequestration, and other technologies enabled by expanded and enhanced transmission and distribution system capabilities.

Significant RD&D will be needed over a sustained period, and technology development lead times demand immediate action. Timely, sustained investment in public and private RD&D could lower the cost of emissions reductions on the order of $1 trillion, and significantly reduce increases in wholesale electricity costs.

The RD&D pathways addressed in this analysis provide a framework for a comprehensive RD&D Action Plan that EPRI will publish later this year. This plan will reflect input from industry and EPRI stakeholders, continuing the broad, collaborative effort to determine the most appropriate technology pathways for achieving substantial CO_2 emissions reductions from the U.S. electricity sector.

EMISSIONS REDUCTION POTENTIAL

The first part of the EPRI analysis evaluated the U.S. electricity sector's potential for reducing CO_2 emissions based on deployment of a full portfolio of advanced technologies: end-use energy efficiency, renewables, nuclear power generation, advanced coal-fired power generation, coal-fired generation with carbon capture and sequestration, plug-in hybrid electric vehicles, and distributed energy resources. This analysis represents an estimate of the potential electricity sector CO_2 emission reductions, in that it focuses solely on technical capabilities, while assuming no economic or policy constraints on emissions.

The emissions reduction analysis concluded that, with significant advances in technology performance and deployment, the technical potential exists to achieve an approximate 45 percent reduction in U.S. electricity sector CO_2 emissions by 2030, relative to base case projections by the U.S. Energy Information Administration.

Accomplishing significant emissions reductions will require aggressive technology development and deployment. The second part of the EPRI analysis identified the sequence of RD&D activities needed to achieve the technology performance and deployment targets required for large-scale emissions reductions. To effectively deploy the full portfolio of advanced technologies, the electricity sector must address challenges that EPRI describes in four technology development pathways over the coming decades:

- Deploy smart distribution grids and communications infrastructures to enable widespread end-use efficiency technology deployment, distributed generation, and plug-in hybrid electric vehicles.
- Deploy transmission grids and associated energy storage infrastructures with the capacity and reliability to operate with 20 to 30 percent intermittent renewables in specific regions of the United States.

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BRITS PUSH WAVE POWER

Funding has been secured for a $57 million wave energy development off the coast of Hayle, in the United Kingdom.

Up to 30 devices designed to generate electricity from the motion of wave will be tested at the facility off the southwest coast of the country.

The project could eventually generate 20 megawatts of electricity, enough electricity for 7.500 homes. Undersea cables will carry power generated by waves from a hub 10 miles offshore to an onshore substation once the project is operational in 2009.

Developers of new wave power generators will be able to test their equipment by plugging into the hub, according to a report in the *Belfast Telegraph*.

- Deploy advanced light water nuclear reactors enabled by continued safe and economic operation of the existing nuclear fleet.

- Deploy commercial-scale coal-based generation units operating with 90 percent CO_2 capture and with the associated infrastructures to transport and sequester the captured CO_2.

The specific technologies in these development pathways are at various stages of development. Given the 10- to 30-year lead-time needed to fully research, develop, and commercially deploy technologies, timely and sustained RD&D investment is critical. EPRI is developing a detailed RD&D Action Plan defining a set of actions to guide advanced technology development efforts, along with estimated RD&D funding requirements.

While advanced technologies are critical to CO_2 emissions reductions, implementation must be considered in association with economic impacts. The third part of the EPRI analysis assessed the economic value of deploying the full portfolio of advanced technologies for emissions reductions. The economic model used for the analysis estimates the least-cost combination of technologies necessary to satisfy the economy's energy services with or without a CO_2 emissions constraint.

The analysis is based on a plausible emissions constraint in which electricity-sector CO_2 emissions are stabilized at 2010 levels through 2020 and then reduced by 3 percent per year through 2050. The analysis determined that advanced technologies could provide $1 trillion in cost savings. This savings represents the difference between compliance costs associated with using a full portfolio of advanced technologies and costs using a limited portfolio of technologies – in other words, incremental improvements beyond current technologies.

Technology availability has a large impact on the generation mix and on forecast electricity prices in a carbon-constrained environment. With a limited portfolio of technology options, emissions reductions require large reductions in electricity demand, possibly placing severe constraints on economic growth. With a full portfolio of technology options, the availability of carbon capture and sequestration and nuclear generation provide large-scale, supply-side emissions reductions so that the electricity market is preserved and constraints on economic growth are limited. Consequently, the availability of advanced generation technologies results in a substantially lower increase in wholesale electricity costs – relative to 2005, roughly 30 percent higher in 2050, as compared to 230 percent higher if emissions constraints are achieved with limited technology options.

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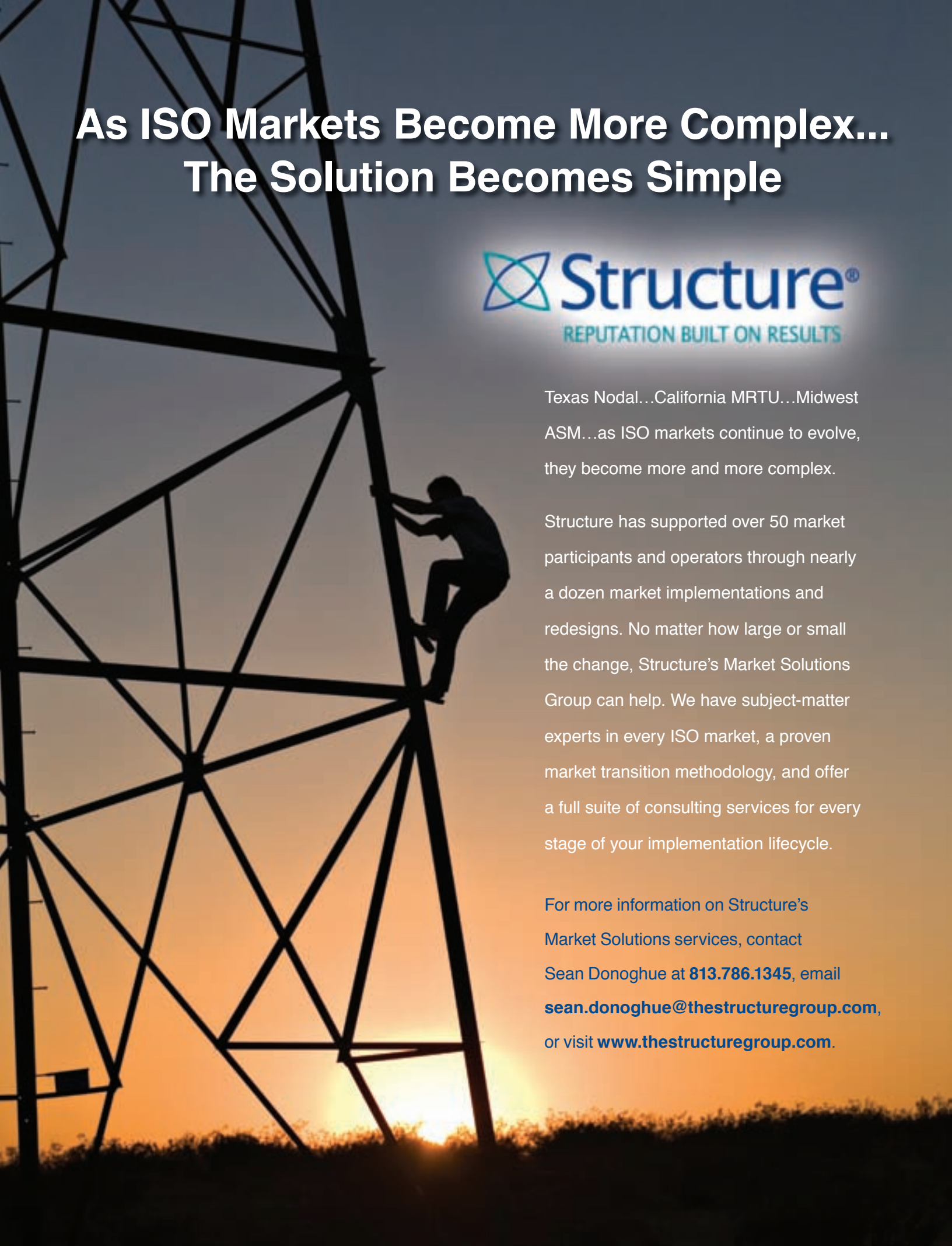

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