

On the Political Economy of Power Market Reform
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by
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Thanks for the opportunity to speak with you on this momentous occasion – the first conference by the Stanford Program on Energy and Sustainable Development. First, on behalf of EPRI, let me express my welcome and appreciation to all of the conference participants. By way of prologue, this landmark program at Stanford is, for EPRI as the founding sponsor, realization of a collaborative vision that emerged from our on-going Electricity Technology Roadmapping initiative. This Roadmap explores and responds to the needs and aspirations of the broad electricity stakeholder community who, in effect, is also its true author.

It was only through their eyes that EPRI, as a technology and engineering research organization, gained the vision to see the essential role that electricity and innovation must play in achieving a sustainable world for its 10 plus billion human inhabitants in this Century. This community of stakeholders sees electricity, in more clearly than many directly engaged in the electricity enterprise, as more than just a form of commodity energy. From the stakeholder perspective, electricity has become the lifeblood of modern economic development and quality of life. As a result, electricity has gained an inescapably dominant political dimension that must be accounted for, but is typically underestimated if not ignored, in the process of power market reform.

The goal of universal electrification envisioned by the Roadmap Stakeholders is as essential as it is daunting and it is in this context that I believe the value of electricity market reform will be ultimately judged. Throughout history, mankind's ability to master its environment has been dependent upon the availability of energy. In this regard, civilizations, and the people they represent, can be seen as thermodynamic systems that grow in proportion to their energy access and are subject to decline when they are unable to sustain productivity and quality of life returns from their available energy. Today, the world is in a period of unprecedented growth in its human population, made possible by a technology revolution that has dramatically increased mankind's ability to harness energy from nature. The result will be a ten-fold world population increase in the 250-year period nominally ending in 2050. It is the growing temperature of this human climate which, I believe, is the greatest global challenge we all face.

The economically developed nations, particularly the U.S., have been both the wellspring and chief benefactor of this profound technological and demographic transformation. But I believe we have now reached a critical point where our own continued well-being depends on substantially increasing the rest-of-the-world's access to energy. This is the crux of the sustainability challenge in the 21st Century. The term "sustainability" is often used or abused to justify many things but like the judge, when asked to define pornography, responded, "I can't define it but I know it when I see it." Certainly our present global energy situation is not sustainable from any perspective. The irony is that the advancements of the Industrial Revolution have been based on a return to a hunter-gatherer type of energy economy, one that our ancestors found unsustainable 10,000 years ago. The only difference is that today we depend on digging and drilling for the remains of dead animals and plants for our energy, while our ancestors pursued living ones. As a result, the developed nations are precariously perched at the

top of an increasingly unstable global energy pyramid. As we read in each day's headlines, this pyramid, based on the inefficient hunter-gatherer harvesting of fossil fuels, is providing diminishing returns at ever greater cost and risk, while still leaving more than half the world's population to subsist on agrarian or less levels of energy access.

Let me emphasize that my comments are not meant as a defense of the limits of growth. Rather as a technologist I have an unshakable belief in the growth of limits. My belief is based on electricity's ability to be the essential agent for resolving the global energy challenge. It has the unique ability to (a) achieve maximum diversity in energy resource access, (b) facilitate maximum energy efficiency, and (c) enable modern technological innovation essential to human opportunity. It is up to us, however, to exploit these advantages for the greater good of mankind and the planet.

Therefore, the essential goal against which electric market reform must ultimately be measured is its ability to stimulate the investment needed to produce universal access to electricity – to “Electrify the World”. The magnitude of the challenge is reflected in the fact that achieving universal access to at least a basic level of 1,000 KWh per person per year will require the investment of at least \$200 billion per year in the developing world for the next 50 years. This is in comparison to the \$20 billion per year China is now investing in electrification, and the total \$3 billion per year invested during the 1990s in electrifying other less developed regions of the world. Capital investment on this much larger scale demands a long-term public/private partnership based on enlightened self-interest, global security and, ultimately, mutual survival. The monies involved are a small fraction of annual defense budgets and are, in fact, less than the world spends on cigarettes. We must find the collective wisdom and leadership to make it happen.

Regrettably, the primary motivation for electricity sector market reform in developed nations so far has typically been less a matter of long-term economic efficiency than short-term cost containment. I believe this expediency has proven to be a primary root cause of market reform disappointment. The emphasis on cost is, however, a natural product of the declining cost commodity business model that has dominated the development of the electric power sector throughout its century-long history in the developed world. This quest for declining cost is certainly typical of true commodity industries, but electricity is a manufactured commodity that has been uniquely dependent on an exceptionally complex and expensive infrastructure for its “just-in-time” production and delivery. During the first 70 years of the 20th Century this quest was, none-the-less, consistently successful as economy-of-scale advances in production and delivery technologies, coupled with rapid demand growth, led to electricity cost reductions that typically averaged 20% per decade. During this period, the electric utility industry developed as a franchised, vertically integrated, monopoly enterprise, state controlled or regulated to assure the essential balance between owner and consumer value. The public/private investment partnership and the obligation to serve embedded in this regulatory compact achieved a standard of performance that effectively made electricity a highly dependable, low cost “entitlement” (from the perspective of consumers and their government representatives) that could generally be taken for granted throughout the developed world.

By the 1970s, the extended period of declining cost that the electric utility industry had enjoyed came to an end. Diminishing economy-of-scale returns coupled with slowing demand growth,

higher fuel costs, and rising environmental requirements converged to challenge the traditional declining cost commodity business model and structure of the electric utility industry. These past 30 years have seen a variety of well-intended efforts, culminating in market reform, all focused first on restoring the electricity sector's declining cost tradition. All have failed to meet the challenge and I see no "silver bullets" on the horizon that are likely to change this reality within the context of the currently dominant technological and institutional infrastructure for electricity. At the same time, electricity has become increasingly politicized as a retail entitlement where political expediency demands that individual consumers (voters) be shielded from price increases literally at all costs. Therefore, the inherent price volatility in a market-based electricity system is likely to be politically tolerated only in one direction – downward. This result fundamentally undermines market operability and has an inevitably chilling effect on investment. When and where large power supply surpluses still exist, such as in areas of Western Europe, market reform is proving to be an effective method for working off the surplus, but it is not generally seen by the companies involved as one that is sustainable.

Where surpluses do not exist, the combination of rising cost and artificially constrained price in a market design that may be subject to manipulation creates a cost vise that tends to extrude more and more public and private value from the power system. This threat is being manifested through the electricity sector's overriding incentive to subsidize its immediate costs at the expense of technological development and investment in its infrastructure. This mortgaging of the future, will, until corrected, inevitably impose a heavy price on a nation's productivity and economy, and on the welfare of its citizens. In the case of the United States, for example, investment as a fraction of electricity revenue during the past 20 years has been at an all-time low – less than half the previous minimum in the depths of the Depression. The result is a growing loss of reliability cost that has now reached over \$100 billion per year. This is the equivalent of a 50-cent price increase on every dollar of electricity purchased and, yet, it is just the tip of the iceberg.

Based on this pattern of experience, the successful market liberalization of electricity supply depends above all on the condition that the public, through its government, be accountable for providing the incentives needed to maintain a robust, reliable, and efficient electricity infrastructure – one designed to keep pace with the needs of all electricity consumers and the society they represent. This requirement is particularly crucial in the context of the power delivery network that must operate as an unconstrained common carrier where producers and consumers have true open access to each other under conditions that maximize market efficiency. In short, markets must be proactively structured to define their service responsibilities.

Finally, and I believe most importantly, confidence in the ability of electricity markets to serve the public interest depends on promoting and applying the innovative revolution underway in electricity technology. Central to this revolution is the conversion of the analog power delivery network designed for monopoly operation to open access digital control, coupled with replacement of the one-way power consumption meter that now effectively shields consumers from market access. Its replacement takes the form of a two-way electronic portal enabling real-time measurement and communication between the consuming and supplying communities, thus achieving real-time market transparency. Such a transformed electricity delivery infrastructure could fundamentally address the growing vulnerability of today's power supply system in terms

of its capacity, reliability, security and ability to support market reform. In addition, it would open the power supply system to incorporating distributed energy resources, including renewables, in a manner that will serve to reduce system vulnerability rather than add to it – as is often the case today – while also steadily improving efficiency and environmental performance. In this manner, the transformed electricity infrastructure may ultimately enable a return to declining electricity supply costs as well.

This technological transformation is equally applicable to both the developed and developing worlds, although the individual applications will need to be tuned to best meet each situation. In fact, this assimilation may in many ways be easier in the developing world where the lack of established infrastructure, both physical and institutional, provides a relatively “clean sheet of paper” on which to apply what are, in fact, more robust and less mechanically complicated technical systems. EPRI is leading an international consortium of power companies, technology firms and governments in the development of this revolutionary power system architecture. An important institutional factor in the success of this transformation is changing the role of the regulator from one of “protecting” the consumer from the market to facilitating access and transparency through technology.

What then can be concluded about the role of market reform in terms of facilitating global electrification? Since surplus electricity supply is, by definition, not a circumstance typically facing the developing world, it is doubtful that market reform, in the context that it has been applied in the developed world, will be the determining factor in promoting the level of investment need to achieve global electrification. Of far greater importance is the existence of stable governments and institutions, confidence in the rule of law, sound fiscal policies, and commitment to an innovative infrastructure capable of supporting liberalized electricity markets. Experience suggests that these are also essential precursors to successful market reform, regardless of the model chosen.

One interesting variation on market reform that seems worth exploring is the local “market” paradigm that is emerging in many rural regions of the developing worlds where electrification occurs “bottom-up” rather than “top-down”. That is, electrification occurs through village-scale minigrid infrastructures under local management and control, and using indigenous energy resources. These local cooperatives provide the direct consumer access and market transparency that large, top-down centralized systems generally lack and – by virtue of their politically-based institutional structure and commodity business-culture – have great difficulty in achieving. The process of expanding rural electrification, whereby these “PC”-like microgrids are encouraged to network with each other in order to expand their mutual capabilities, would seem to be a fertile situation for expanding their locally established market culture as well.

All other factors being equal, perhaps the most important advantage in building electricity markets from the ground up, relative to reforming the status-quo, is the more encouraging environment they may produce for both innovation and investment.

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