

California Electricity Market Crisis: Causes, Remedies and Prevention

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1. Introduction

The competitive electric power market of the State of California began operation on March 31, 1998 with the California Independent System Operator (California ISO) and the now bankrupt Power Exchange (PX) as the main operationally independent market facilitators. The market took off smoothly and the prices were seemingly just and reasonable until May 2000 when the first signs of market crisis emerged. This marked the beginning of the California power crisis that continued until about May 2001. During that period, California was confronted with an unprecedented electricity crisis, which threatened to undermine the reliability of its electricity system, weaken its economy and impact energy markets throughout the western part of the United States.

2. Root Causes of the California Power Crisis

The initial causes of the high wholesale market prices reflect a complex mixture of drought conditions that reduced hydroelectric power production (particularly in the northwest region) and corresponding low power import levels, a growing economy that fueled demand for power, dramatically higher and volatile natural gas prices, lack of sufficient generating capacity in California and throughout the US western region, inadequate transmission infrastructure, inadequate demand responsiveness or lack of demand elasticity, lack of forward contracting, forward scheduling that resulted in the huge reliance on the spot market, and the Federal Energy Regulatory Commission's (FERC) "hands off" approach in regulating wholesale markets. The above-mentioned anomalies, among others, culminated into a "perfect storm" and consequently, led to the significant market power abuses in California. The problems were further compounded by the potential financial insolvency of the investor-owned utilities (IOUs). The increasing deterioration of the financial solvency of California's three investor-owned utilities (IOUs) further shattered all vestiges of a "normal" deregulated electricity market. Effectively, the California ISO, IOUs and state government

overseers had to resort to desperate measures in keeping the lights on in California with the limited available resources.

The crisis had its origins in the unintentional mistakes and miscalculations adopted at the time the electricity sector was restructured in California through the Assembly Bill 1890 (AB 1890) in 1996. Two mistakes stand out as critical. First, California required utilities to make nearly all their electricity purchases on a volatile spot basis, divest a substantial portion of their generation without allowing them to enter into long-term contracts to ensure stable and “reasonable” prices during the transition period following deregulation. The lack of demand responsiveness to hourly prices were partly due to technical capability limitation for real time price responsiveness, ambiguous accountability for the acquisition of reasonably-priced power for retail consumers, and lack of adequate forward contracting for energy. Transition contracts are found in every successful electricity market, as well as in other unregulated commodity markets, and are particularly important where the utilities divest generation, but have obligations to serve remaining customers. Secondly, California froze retail rates at ‘low levels’ and banked on low wholesale prices to support a profit margin high enough to enable the utilities to pay off historical, uneconomic investments including stranded costs. Although frozen at 10% below 1996 levels, the rates were supposedly high at the time, compared to what a competitive market would presumably have produced. The fixed retail level price discouraged end users from undertaking normal market responses: to conserve and/or to take advantage of the allowed customer choice, and opt for an alternative retail supplier. Those responses would have helped restrain prices.

However, in May 2000, wholesale market prices soared due to rising demand, dramatically fixed retail prices blocked conservation efforts by insulating consumers from market realities and reduced consumer incentives to turn to competitive retailers. The heavy reliance on spot market purchases, combined with demand that was unresponsive to prices, helped drive prices higher.

3. Impact of Stakeholders and Creditworthiness

The energy prices were low to moderate in the first couple of years. However, the IOUs managed to sell a good portion of their generation assets at attractive prices, expediting the recovery of stranded costs, presumably due to the Reliability Must-Run (RMR) contracts that most of the divested units had, that afforded them to sell above book value. Unfortunately, the utilities had already divested most of their generation plants without being allowed by the California Public Utility Commission (CPUC) to secure contracts that would have ensured their right to buy back the power at some fixed backstop price. The CPUC felt that such contracts would add unnecessary costs to consumers’ electricity bill and were concerned about “self-dealing” by the utilities. The divestitures of generation assets by the utilities that were encouraged and sanctioned by the CPUC, exposed the utilities to the financial costs associated with high wholesale (purchase) prices and low fixed retail (sale) prices. Meanwhile, the IOUs were losing money on the electricity they were buying for resale to their customers. The inversion of the typical wholesale-retail price relationship brought these utilities to the brink of bankruptcy. The perceived risk of “non-payment” in turn caused generators to be reluctant suppliers, even at dramatically elevated wholesale prices. The natural reluctance of suppliers to supply voluntarily when they did not expect to

get paid was a substantial contributor to the rising prices and rolling blackouts that was seen in California in the early months of 2001.

The destruction of the utilities' credit worthiness and the resulting responses by suppliers shattered all vestiges of a normal market. Consequently, California had to deal with both a financial crisis and an electricity supply crisis. With the utilities' credit quality destroyed, suppliers fearful of not being paid for their supplies, became reluctant to sell into the California market. In effect, the utilities and their state government overseers had to resort to desperate measures to keep the lights on with the available limited resources– with only limited success. Figure 1 shows some employees of the California ISO in the energy control center from where the California ISO worked diligently to keep the lights on – a task that was on-going until FERC ordered a market mitigation framework in collaboration with the California ISO in December 2001 to ensure stability, and “just and reasonable” prices in the California ISO electricity markets. However, this framework which was ordered by FERC to stop the “bleeding” expires on September 30, 2002.



Figure 1. A Section of the California ISO Control Room
L-R: Dr. Anjali Sheffrin, Director, Department of Market Analysis, Dr. Chris Mensah-Bonsu, Market Design Engineer, Market Operations, Mr. Mark Rothleder, Manager, Market Integration

4. Pedagogical Interests and Conclusions

The California power crisis was so unprecedented that it stimulated nation-wide educational debates and discussions, as well as learning experience among industry practitioners, regulatory policy makers, academicians and market participants. In order to fully understand the causes, potential remedies and how to prevent similar crisis in other parts of the world, there was the need to understand the policy issues, economic as well as the operations perspective of the situation. The impact of such a national crisis prompted the Power Engineering Society of the Institute of Electrical and Electronic Engineers (IEEE PES) to investigate the issues involved, and to avail itself with those complex experiences of the California Electricity Market Crisis. Hence, Dr. Chris Mensah-Bonsu of the California ISO's

Market Operations group, together with Dr. Shmuel Oren of the University of California, Berkeley were appointed by the IEEE PES Society to organize and chair a panel session under the auspices of the PES System Economics Subcommittee on the above subject. Figure 2 shows a photograph of the distinguished panel session participants.



Figure 2. Participants of the “California Electricity Market Crisis: ...” Panel at the IEEE PES 2001 Summer Meeting in Vancouver, Canada

L-R: Mr. Gary B. Ackerman (standing), Dr. Shmuel Oren (panel co-chair), Dr. Chris Mensah-Bonsu (panel chair), Dr. Dejan J. Sobajic, Dr. Anjali Sheffrin, Mr. Vikram S. Budhraj, Dr. Edward Kahn

The goal of the panel session was to bring together individuals who had first-hand experience with various aspects of the California electricity market crisis, either through analysis of its underlying cause, or involvement in mitigation efforts to deliberate on the issues involving California. The panel speakers who are experts in their fields addressed the session on a variety of issues including, the California ISO operations, electricity supply, demand side responsiveness, abuse and exercise of market power and its mitigation, long term contracting, regulation and the underlying policies in their quest to recommend solutions that are pertinent to the complex California electricity market.

The panel session took place at the IEEE PES 2001 Summer Meeting in Vancouver, British Columbia, Canada on July 16, 2001. The following were the distinguished panel speakers and their presentation topics:

- California Electricity Market Crisis: Viewpoint of the System Operator
Dr. Anjali Sheffrin, Director-Department of Market Analysis, California ISO, California
- A Quantitative Analysis of Pricing Behavior In California's Wholesale Electricity Market During Summer 2000
Dr. Edward Kahn, Vice President-Analysis Group/Economics, California

- Western States Power Crisis – EPRI White Paper – An Overview
Dr. Dejan J. Sobajic, Director-Grid Reliability/Power Markets, EPRI, California
- California's Electricity Crisis
Mr. Vikram. S. Budhreja, President, Electric Power Group, California
- Reinventing the Grid: The Western Gambit
Mr. Gary. B. Ackerman, Executive Director-Western Power Trading Forum, CA

Biographies

Chris Mensah-Bonsu (aka “*Dr. CMB*”) holds the Ph.D. (2000) and Masters (1997) degrees in Electrical Engineering from Arizona State University (ASU), Arizona and Cleveland State University (CSU), Ohio respectively. Dr. Mensah-Bonsu also received his “Ing.-Dipl.” (1994) degree in Electrical Engineering from the Higher Institute of Mechanical and Electrical Engineering in Varna, Bulgaria. He was a Part-Time Lecturer and Graduate Research Assistant at CSU from 1996-1997, and a Graduate Research Associate and Teaching Associate at ASU from 1997-2000, all in the Department of Electrical Engineering.

At the California ISO, Chris is actively involved in the technical design, implementation, integration, testing, documentation, support and coordination of CA ISO market applications and protocols to ensure efficient markets, system reliability, and FERC compliance. He was involved in the Comprehensive Market Redesign and Market Stabilization Plan special projects. His research interests are in the areas of power grid congestion management, system reliability issues pertaining to competitive electricity markets, network modeling and market design. He has authored journal papers in the area of Global Positioning Satellite (GPS) system applications in power systems, and dynamic line ratings. Dr. Mensah-Bonsu holds membership to several professional institutions, including the National Society of Black Engineers (NSBE), Institute of Electrical and Electronics Engineers (IEEE), Power Engineering Society (PES) and IEEE PES System Economics Technical Subcommittee. He is also a Fellow of the Preparing Future Faculty (PFF) Program. Dr. Mensah-Bonsu has organized and chaired a number of IEEE panel sessions and authored technical peer-reviewed journal papers.

Shmuel S. Oren is Professor of Industrial Engineering and Operations Research at the University of California at Berkeley and former Chairman of that department. Dr. Oren is also the Berkeley site director of PSerc – a multi-university Power Systems Research Center sponsored by the National Science Foundation and industry members.

His research and consulting activities over the last two decades have focused on the development of analytical models and tools and on the design and economic analysis of market mechanisms for the electric power industry. Dr. Oren has served as a consultant to private and public organization, most recently to the Brazilian Electricity Regulatory Agency (ANEEL) and to the Texas Public Utility Commission on issues related to the design of competitive electricity markets. His extensive publications include topics such as pricing of demand side contracts, auction design, transmission pricing, electricity market restructuring and other related topics. Dr. Oren holds B.Sc and M.Sc degrees in Mechanical Engineering from the Technion in Israel and M.S. and Ph.D degrees in Engineering Economic Systems from Stanford University. He is an IEEE Fellow.