SYSTEM DYNAMICS AND UNCERTAINTY:

Results of Two Applications of Formalized Sensitivity Analyses with System Dynamics Models of the Electric Utility Industry

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Well structured system dynamics models are often quite useful in the analysis of policy impacts in the face of multiple sources of uncertainty. Simulation searches for a "robust" policy that performs well under widely varying conditions are often the most rewarding portion of a system dynamics study. This paper reports the results of two studies where the analysis of uncertainty is carried a step further. Here, we are interested not only in policy impacts under widely varying conditions but in whether a policy can reduce the uncertainty of the system.

The paper begins with an important example from the electric utility industry. Utility planners are interested in learning the extent to which efficiency standards for new homes and businesses lead to an important reduction in the uncertainty of the electric utility system. The planners generally agree that uncertainty in the number of new homes and businesses translates into less uncertainty in electric load if the new buildings are more efficient in their use of electricity. And many planners feel that reduced uncertainty in electric load growth will lead to reduced uncertainty in other variables like the average price of electricity.

Two recent studies have been completed which combine system dynamics models of electric utility systems with a formalized statistical analysis techniques described at the 1983 International System Dynamics Conference. One study was performed for the California Energy Commission for a hypothetical California utility; the second was performed for the Bonneville Power Administration for the Pacific Northwest electric system. (The Bonneville model is explained in papers at the 1985 and 1986 conferences.)

The paper provides a short review of how utility planners commonly represent the long term uncertainty in system performance. Key differences between the system dynamics/statistical analysis approach and the more common methods are identified. Selected results are presented to illustrate the usefulness of the method. We conclude with a discussion of several highly unusual findings from the Bonneville study. The discussion of the "counter intuitive" results focuses on the key role of information feedback in the Bonneville model.

THE IMPACT OF PERFORMANCE STANDARDS ON THE UNCERTAINTY OF THE PACIFIC NORTHWEST ELECTRIC SYSTEM

A FINAL REPORT ON THE HYPERSENS ANALYSIS OF CPAM

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BONNEVILLE POWER ADMINISTRATION
OFFICE OF CONSERVATION

CONSERVATION AND UNCERTAINTY:

AN ILLUSTRATIVE ANALYSIS FOR THE CALIFORNIA ENERGY COMMISSION

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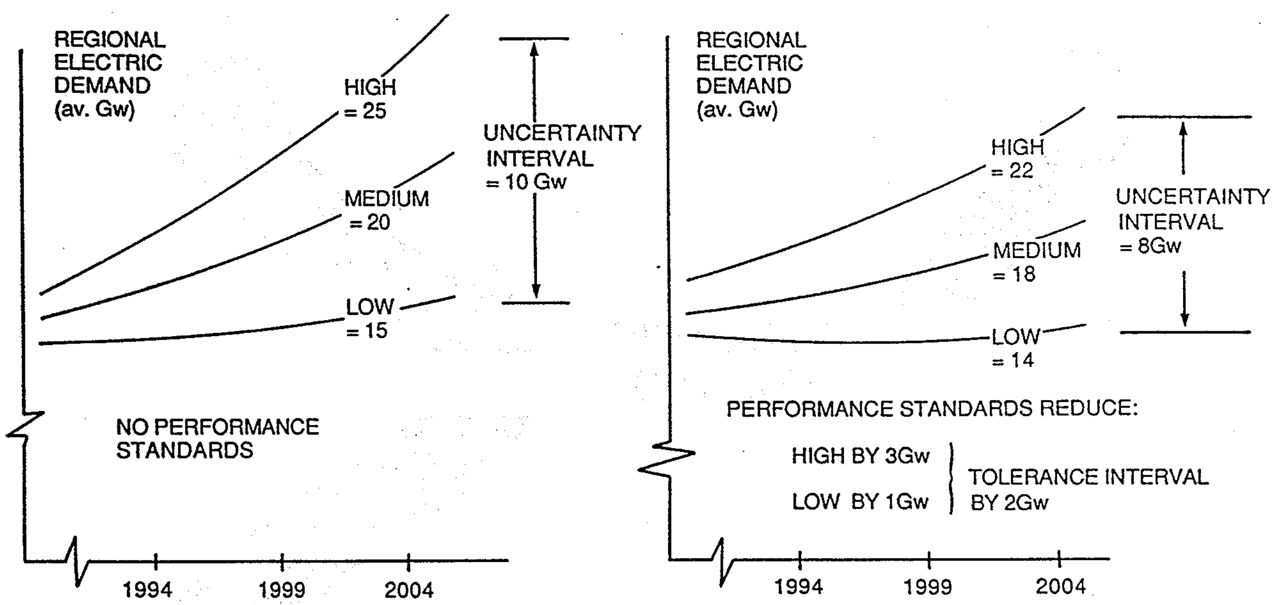
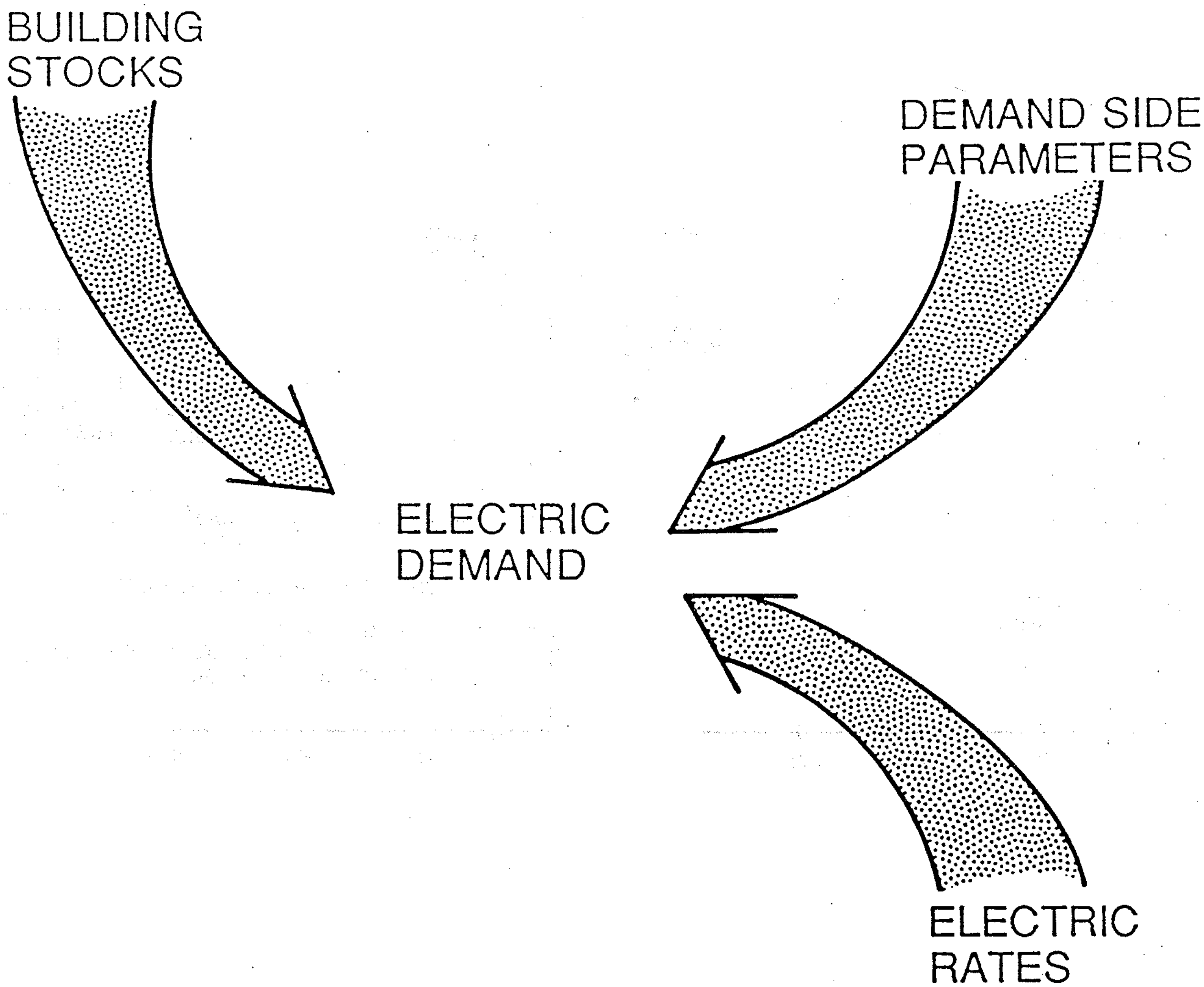
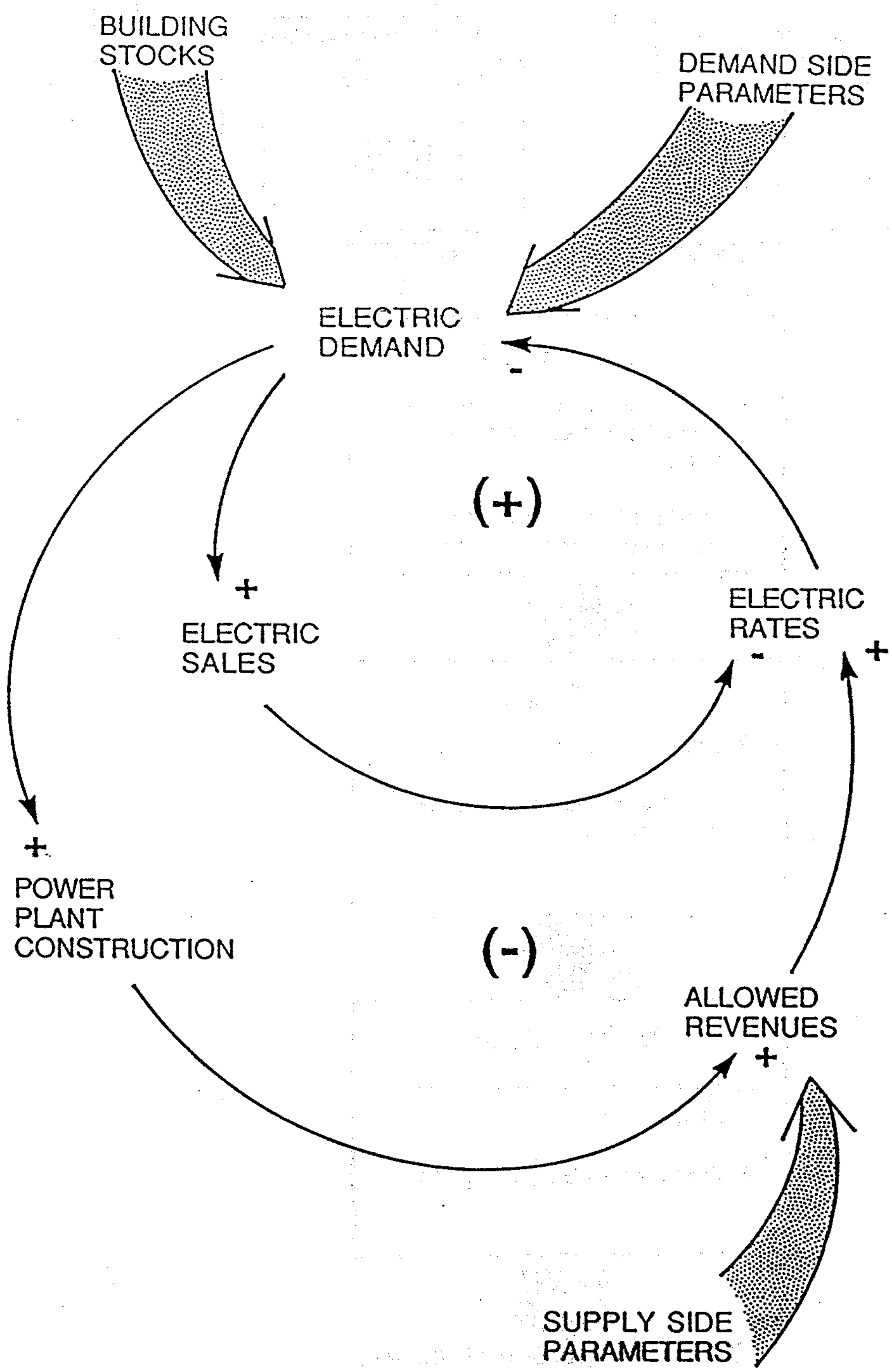
A SIMPLE NUMERAL EXAMPLE OF UNCERTAINTY REDUCTION



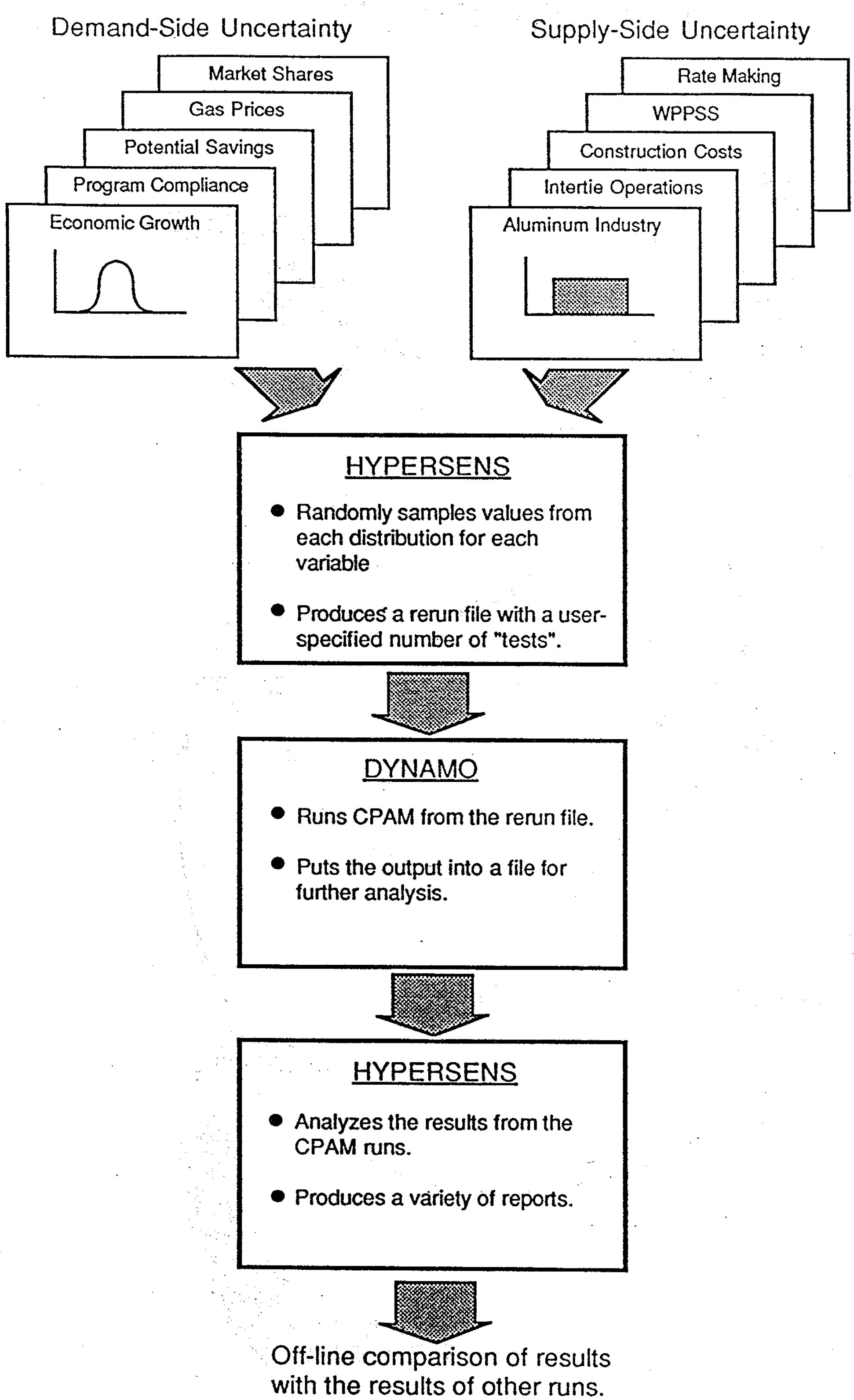
ANALYSIS WITHOUT PRICE FEEDBACK



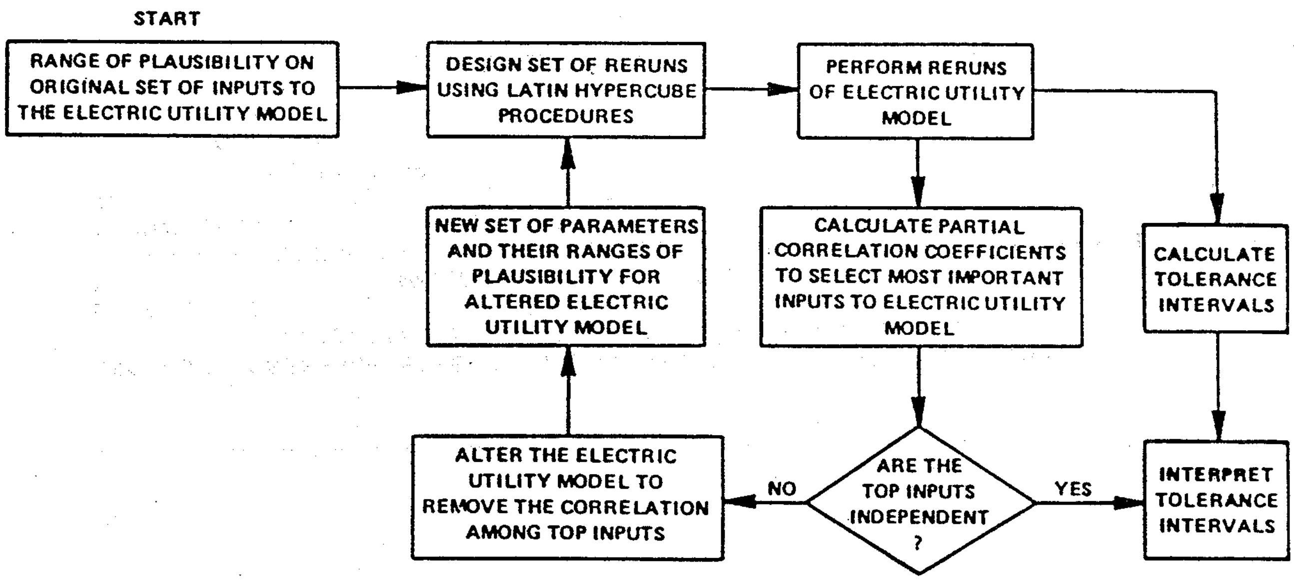
ANALYSIS WITH PRICE FEEDBACK



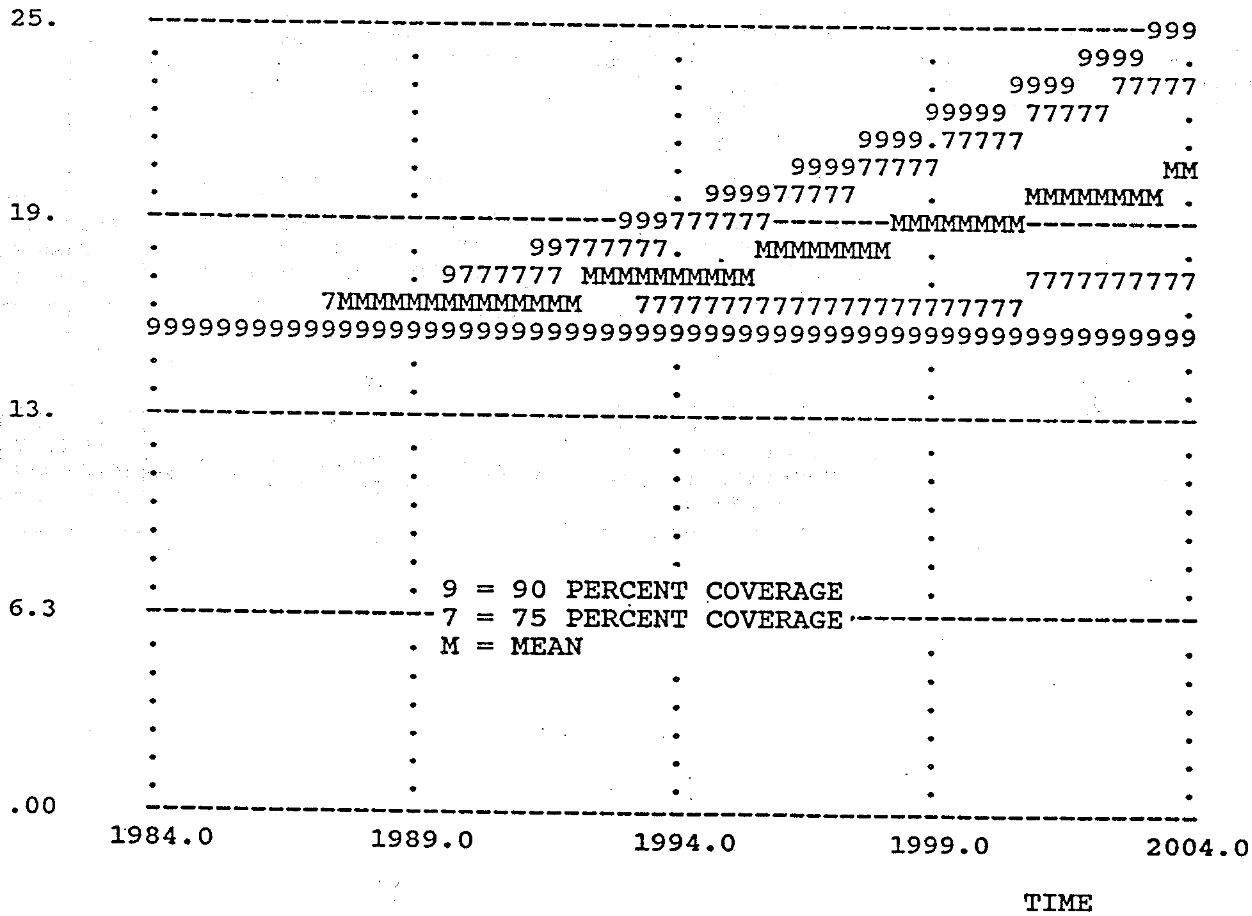
USING HYPERSENS WITH CPAM



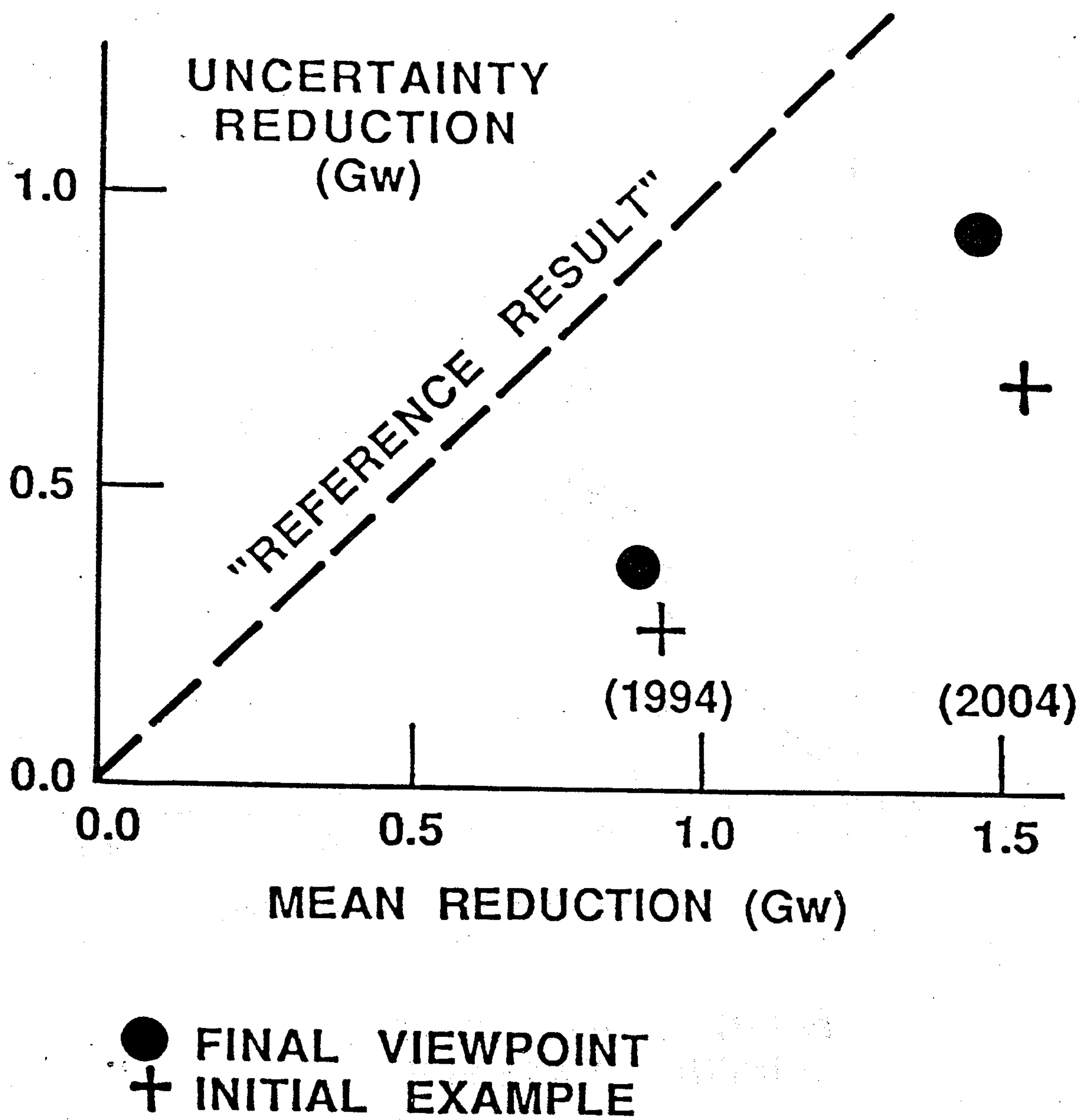
THE ITERATIVE APPLICATION OF HYPERSENS



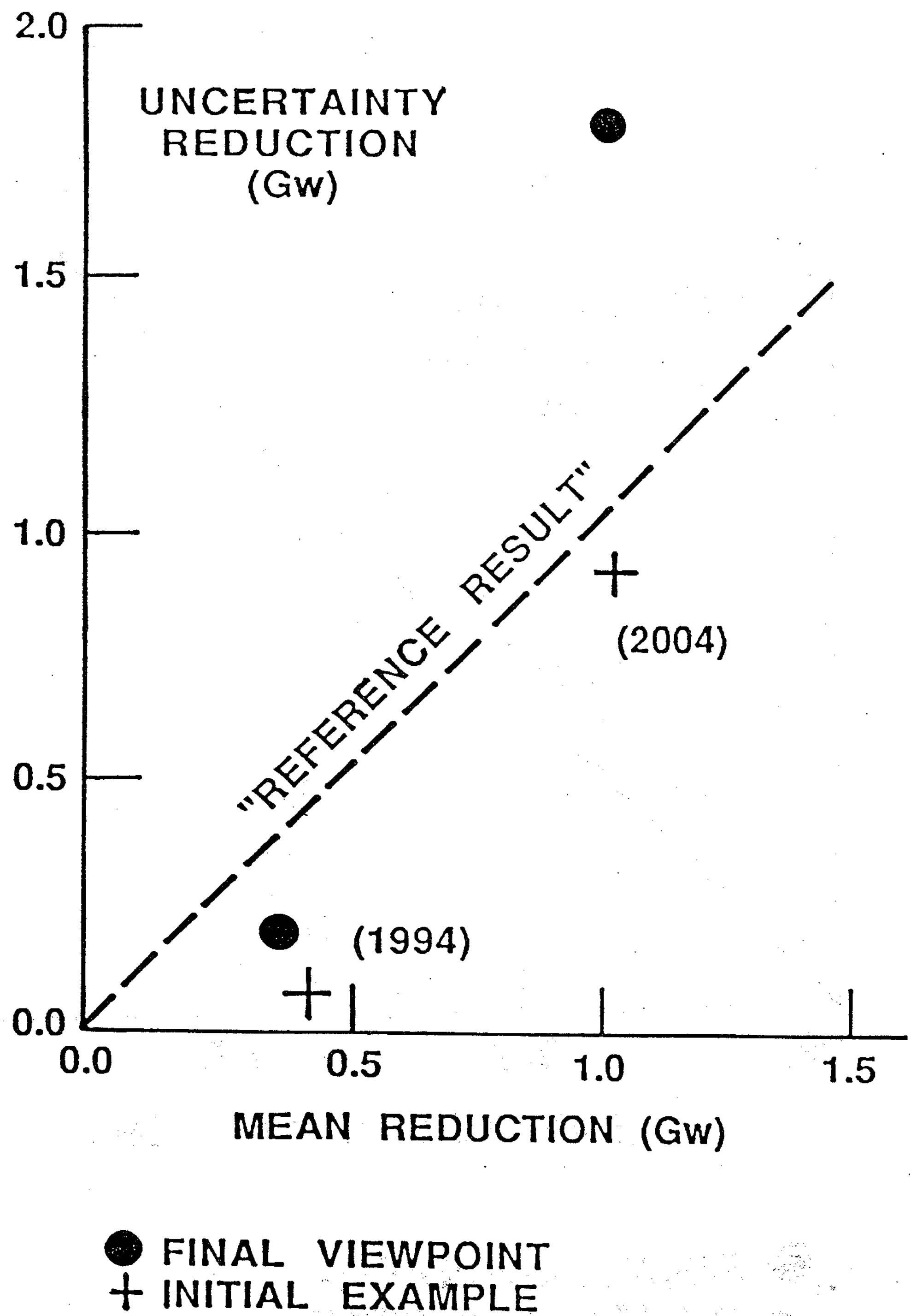
HYPERSENS TOLERANCE INTERVALS FOR REGIONAL DEMAND



STANDARDS' IMPACT ON REGIONAL DEMAND WITH THE INITIAL AND FINAL VIEWPOINTS



STANDARDS' IMPACT ON BONNEVILLE LOAD WITH THE INITIAL AND FINAL VIEWPOINTS



RELATIVE IMPORTANCE OF THE REDUCED OPTIONS COSTS MADE POSSIBLE BY THE REDUCTION IN DEMAND UNCERTAINTY

	DISCOUNTED UTILITY REVENUES	DISCOUNTED ENERGY SERVICE COSTS	AVERAGE RETAIL ELECTRIC RATE
SIMULATED IMPACT OF PERFORMANCE STANDARDS UNDER BASE CASE CONDITIONS	BENEFIT OF $2.835 BILLION	PENALTY OF $1.262 BILLION	BENEFIT OF 0.01 mills/kwh
EXTRA BENEFIT FROM THE REDUCTION IN OPTIONS COSTS	$0.177 BILLION	$0.177 BILLION	0.12 mills/kwh
RELATIVE IMPORTANCE OF THE REDUCTION IN UNCERTAINTY	6%	14%	VERY LARGE