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**Presentation Title:** Lessons from the Field – Best Practices for Supercomputer Implementation and Evaluation

**Abstract:** Within the information technology (IT) industry, supercomputers represent the largest and most powerful computing resources deployed, with rapidly expanding computing power and associated increases in energy consumption. Within the past 10 years, the performance of the top 500 most powerful supercomputers in the world (from Top500.org) have increased from approximately 10 teraflops to more than 1 petaflops (1,000 teraflops), with associated increases in energy usage. Trends indicate similar or even greater increases in power in future years due to the ever-increasing worldwide demand for supercomputers. The uncertainty inherent in projecting the evolution of this technology during the lifetime of a system's use – as well as substantial per system energy usage – presents a number of challenges to those developing energy efficiency incentive programs and to those evaluating those programs.

The authors recently completed an impact evaluation of a large industrial incentive program that included several supercomputer projects. The research, data gathering, and analysis that went into the evaluation of these projects yielded valuable information for both program implementers and evaluators faced with supercomputer projects. This paper will detail the challenges associated with implementing and evaluating supercomputer projects and our recommended best practices surrounding the following:

1. Baseline determination: With the rapid increase in efficiency, how should implementers and evaluators set and defend baseline efficiency?
2. Loading and uptime: New supercomputer installations plan for large loading and near constant uptime, but actual utilization may vary. Are similar levels of loading reflected in ex post data? How can evaluation validate the actual energy efficiency and energy use of these machines?
3. Idle demand: Idle demand is often overlooked, perhaps due to the belief that the computer will be under constant, steady load. How does idle load impact energy use at part-load conditions, and can it negatively impact ex ante estimates of savings?
4. Interactivity with HVAC systems: Given the large power draw and heat rejection of this equipment, what are impacts on HVAC systems serving these spaces? Are the impacts minor compared to the supercomputer energy use and therefore can be ignored, or should implementers and evaluators approach these ancillary systems with the same level of rigor applied to the supercomputers themselves?

The positions presented in the paper are supported by actual experience evaluating supercomputers as well as secondary research into the trends of supercomputer capacity, speed, and efficiency.