Case Study – Data Center

St. Paul Data Center Power Quality Study: **Controlled Environment Powerhouse On and Off Comparison.** Impact of Powerhouse System:

1. Voltage Stability: The increase in average voltage from 276.066 V to 280.431 V **(1.58% increase)** with the Powerhouse system means better voltage regulation and reduced risk of undervoltage issues that can harm sensitive equipment. Stable voltage is crucial for maintaining consistent performance and prolonging the lifespan of electronic devices.

2. Current Reduction: The average current decreased significantly from 473.304 A to 358.685 A **(24.19% decrease)** with the Powerhouse system. This reduction minimizes electrical losses and improves the efficiency of power distribution within the facility. Notably, the heat generated in the conductors is reduced by approximately 42.5% due to this lower current, leading to less thermal stress on conductors, enhanced lifespan of electrical components, and potentially reduced cooling requirements.

3. Apparent Power Efficiency: The reduction in average apparent power (KVA) from 391.999 kVA to 301.816 kVA **(23.03% decrease)** indicates a more efficient use of the power supplied to the facility. This reduction can lead to significant savings on demand charges, estimated at about $16,233 annually if the demand charge rate is $15 per kVA-month.

4. Reactive Power Control: Changing average reactive power (KVAR) from **213.267 kVAR to 21.531 kVAR** indicates a shift from inductive to capacitive behavior. This correction in power factor, as outlined by the EPA, leads to lower transmission losses, improved voltage levels, and decreased demand charges, which are financially beneficial for large energy consumers like data centers.

5. Optimal Power Factor: Achieving a power factor of 1.00 from 0.83 with the Powerhouse system **(20.48% improvement)** maximizes the efficiency of power use. A high-power factor, as per the U.S. Department of Energy (DOE), ensures that most of the power drawn is used for productive work, minimizing losses and potentially reducing the need for expensive infrastructure upgrades.

6. THD Reduction: The decrease in Total Harmonic Distortion (THD) from 18.7% to 11.1% **(40.49% reduction)** ensures fewer disruptions and extends the lifespan of electronic equipment. According to the EPA, lower THD improves the reliability of power systems and prevents malfunctions in sensitive equipment, crucial for uninterrupted data center operations.

7. Environmental Impact and Sustainability: Annual energy savings of 193,400 kWh.