Data centers consume about 100 billion kilowatt-hours of electricity annually, and the growing need for the diverse services data centers offer has prompted a steady increase in their number.

Today, data centers primarily use AC utility power, which is converted in multiple steps within a data center to different voltage levels needed by the chips inside the IT equipment. About 10-20 percent of the energy is wasted in this conversion process. DC-powered data centers provide a natural way of eliminating these losses. In addition, DC-powered data centers are intrinsically more reliable and permit renewable power sources to be easily used. Our research projects are intended to validate and quantify these benefits.

The initial projects include: validation of the benefits and improved reliability of DC power usage in data centers; new management and control techniques of DC-powered data centers that exploit their full potential; optimized techniques for power distribution and delivery, including use of new power conversion devices, fast arc detection and protection, and integration of distributed energy sources; and cooling techniques for DC-powered data centers and power conversion devices.

With funding from the National Science Foundation, the Center for Energy-Smart Electronic Systems (ES2), a National Science Foundation Industry/University Cooperative Research Center (I/UCRC), has teamed up with the Grid-Connected Advanced Power Systems (GRAPES) I/UCRC, the Power Systems Engineering Research Center at the Georgia Institute of Technology and the Integrated Electronics Engineering Center at Binghamton University. Industry partners and consortia participating in the projects include Steel ORCA, dcFUSION, Power Analytics Corp., PHIUS, EDCS Power, NodeCom, Emerson, Panduit and others.

What’s the problem?

- Data centers are increasing in size and number.
- Significant power losses occur in the process of distributing and converting AC power to low-voltage DC required by chips within servers, networking and storage devices.
- Virtualization and other dynamic IT provisioning techniques reduce effective power delivery capacity because of power phase imbalances in AC-powered data centers.

How will we address it?

- Establish an experimental hybrid AC/DC-powered facility to:
  - Demonstrate new management and control techniques to highlight the advantages of using DC power
  - Demonstrate advantages of integrating renewable energy sources and in capping power draw from utilities
  - Establish new metrics for comparing AC- and DC-powered data centers
- Validate improvements in operational reliability and availability.
- Examine new devices and cooling systems for DC power conversion

Why collaborate with us?

- Participate in collaborative research projects that impact your organization.
- Network with other industrial members.

How do I get involved?

- To learn more about this collaborative effort, contact Andrea Palmeri at apalmeri@binghamton.edu or 607-777-3629.