

## **Introduction to Advanced Electric Infrastructure**

The GCEP efforts in advanced electric infrastructure stem from the recognition that a future power system will need to operate differently in a carbon-constrained world. There are many technical challenges to integrating carbon-free energy carriers from renewable resources and other distributed sources into the electricity network. The existing paradigm for communication, command and control in the power system cannot accommodate a high penetration of deeply distributed renewable energy or an influx of electric vehicles. The requirements for bi-directional information and power flows are not in place nor optimized. GCEP anticipates that the future generation mix will range in load response times and capacities, posing complex research issues for power quality, asset management, network control and reliability.

The project in advanced electric infrastructure is in its third year of funding and is a multi-institutional effort that examines a system-wide effort in the control of the electric network to allow over 50% penetration of renewable energy. This team is led by Professor Kevin Tomsovic at the University of Tennessee, Knoxville and includes three other institutions, University of Illinois, Northeastern University/Tufts University and Rensselaer Polytechnic Institute. The researchers are addressing the five issues surrounding command and control of the electric grid: flat control and communication framework, intelligent device interfaces, optimization with multi-scale energy sources and demands, transmission grid management and operation and test and verification. Progress in the past year has been in networked dynamic state estimation, adaptive power-flow control, generalized dynamic phasors, and fault location. Over the past year, there have been four paper submissions and publications, seven conference proceedings and two graduate level theses.