

Overview of the TCIPG Project

A Stronger, More Resilient Power Grid

Our quality of life depends on the continuous functioning of the nation's electric power infrastructure. That, in turn, depends on the health of an underlying computing and communication network infrastructure that is at serious risk from malicious attacks on grid components and networks, as well as from accidental causes, such as natural disasters, misconfiguration, or operator errors.

The Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) project, a unique partnership of four academic institutions, was formed to meet those challenges. We continually collaborate with national laboratories and the utility sector to protect the U.S. power grid by significantly improving the way the power grid infrastructure is designed, making it more secure, resilient, and safe.



In both technology and impact, TCIPG is a **successful partnership of government, academia, and industry.**

Leading the Way

Back in 2005, the electricity sector was largely “security-unaware.” Thanks in part to TCIPG, there has since been **widespread adoption of security best practices.** TCIPG led that transition by conducting breakthrough research, by participating on national panels, and in drafting key documents. However, because the threat landscape continuously evolves, resiliency in a dynamic environment is key. **TCIPG will continue to lead the way.**

TCIPG comprises several dozen researchers, students, and staff from four partner universities: the University of Illinois at Urbana-Champaign, Arizona State University (formerly UC Davis), Dartmouth College, and Washington State University. TCIPG faculty, students, and research staff have developed interdisciplinary expertise essential to the operation and public adoption of current and future grid systems. TCIPG brings together **recognized leaders** in power engineering; computer science and engineering; advanced communications and networking; smart grid markets and economics; and Science, Technology, Engineering and Math (STEM) education.

TCIPG is funded by the **Department of Energy** Office of Electricity Delivery and Energy Reliability (DOE-OE) and the **Department of Homeland Security** Science and Technology Directorate (DHS S&T) as part of the DOE Cybersecurity for Energy Delivery Systems (CEDDS) portfolio. It is the successor of an earlier project established with funding from the National Science Foundation in 2005. In June 2014, TCIPG entered the fifth year of its five-year period of performance.

TCIPG Research in Smart Grid Resiliency

Countering threats to the nation's cyber systems, including both conventional information technology systems and cyber systems in critical infrastructure, has become a major strategic objective. Smart grid technologies promise advances in efficiency, reliability, integration of renewable energy sources, customer involvement, and new markets. To realize those benefits, the grid relies on a cyber measurement and control infrastructure that includes components ranging from smart appliances at customer premises to automated generation control.

TCIPG research has produced important results and innovative technologies in the following areas:

- Detecting and responding to cyber attacks and adverse events, as well as incident management of these events.
- Securing of the wide-area measurement system on which the smart grid relies.
- Maintaining power quality and integrating renewables at multiple scales in a dynamic environment.
- Advanced testbeds for experiments and simulation using actual power system hardware “in the loop.”

Education and Outreach

There is a national shortage of professionals who can fill positions in the power sector. The skills required for smart grid engineers have changed dramatically. TCIPG **graduates are well-prepared** to join the cyber-aware grid workforce as architects of the future grid, as practicing professionals, and as educators.

TCIPG has conducted **short courses** for engineers as well as for DOE program managers. The 2013 offering of our biennial TCIPG Summer School hosted more than 170 participants, including university students and researchers, utility and industry representatives, and government and regulatory personnel.

TCIPG organizes a **monthly webinar** series (first Friday of the month, September–May, 1:00 p.m. Central Time) featuring thought leaders in cyber security and resiliency in the electricity sector. Audiences of more than 100 from industry, government, and academia are typical.

In alignment with national STEM educational objectives, TCIPG conducts **extensive STEM outreach to K-12 students and teachers**. TCIPG has developed interactive, open-ended apps (iOS, Android, MincecraftEdu) for middle-school students, along with activity materials and teacher guides to facilitate integration of research, education, and knowledge transfer by linking researchers, educators, and students.



Collaboration

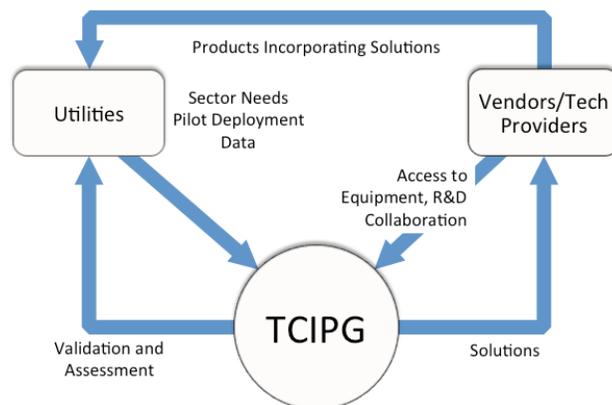
The **electricity industry** in the U.S. is made up of thousands of utilities, equipment and software vendors, consultants, and regulatory bodies. In both its NSF-funded and DOE/DHS-funded phases, TCIPG has actively developed extensive relationships with such entities and with other researchers in the sector, including joint research with several national laboratories.

The involvement of industry and other partners in TCIPG is vital to its success, and is facilitated by an extensive **Industry Interaction Board (IIB)** and a smaller External Advisory Board (EAB). The EAB, with which we interact closely, includes representatives from the utility sector, system vendors, and regulatory bodies, in addition to DOE-OE and DHS S&T.

Partnerships & Impact

While university-led, TCIPG has always stressed **real-world impact and industry partnerships**. That is why TCIPG technologies have been adopted by the private sector.

- Several TCIPG technologies have been or are currently deployed on a **pilot** basis in **real utility environments**.
- A leading equipment vendor **adopted our advanced technologies** for securing embedded systems in grid controls.
- Three **startup companies** in various stages of launch employ TCIPG foundational technologies.



Leadership

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