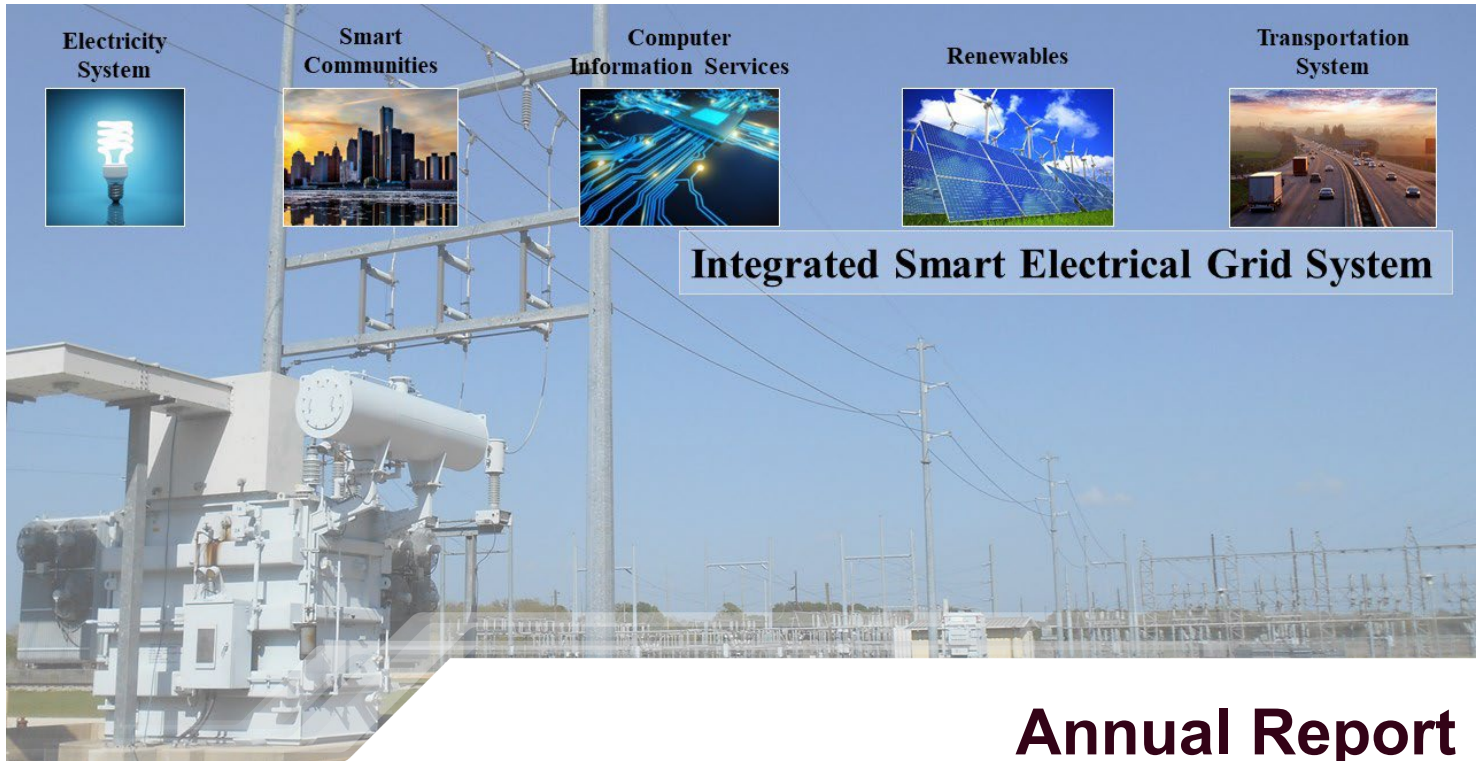




SMART GRID CENTER

TEXAS A&M ENGINEERING EXPERIMENT STATION



Annual Report

September 2020 - August 2021

The main goals of the TEES Smart Grid Center (SGC) were: 1) Developing strategic large-scale research projects; 2) Pursuing research projects funded by the SGC partially based on its membership with companies; 3) Giving online short courses; and 4) Hosting SGC webinars.

Membership of Smart Grid Center

The following companies have SGC memberships:

- CenterPoint Energy, Full Member
- Entergy, Associate Member
- ERCOT, Full Member
- Texas Co-Op Power (United Cooperative Services, Bluebonnet EC, Farmer's EC, Grayson-Collin EC, Mid-South Synergy), Full Member.

Research Projects Funded by the Center

- "Predictive Outage and Asset Management Decision-making Tool Assisting Distribution Operators", PI: M. Kezunovic (ECE TAMU)

- "Application of Texas A&M Electric Grid Control Center testbed", PI: T. Overbye, Co-PIs: K. Davis and K. Shetye (ECE TAMU)
- "Distributed Generation and Its Impact on Market and Protection", PI: L. Xie, Co-PIs: D. Kalathil, M. Begovic (ECE TAMU)
- "Application of Deep Learning for Electric Grid Problems", PI: B. Don Russell, Co-PIs: C. Benner, Thomas Overbye (ECE TAMU)
- "Impact of Customer Owned Battery Storage on the Grid", PIs: Miroslav Begovic and Chanan Singh (ECE TAMU)

Strategic Project Focus Areas

Microgrids; Cyber-physical security with emphasis on interactions between different critical infrastructures; Future wholesale ancillary service products and retail market participation strategies; Synthetic grids; Impact of geomagnetic disturbances on power grid; Big data including weather



Smart Grids Control Room Lab is located at the Center for Infrastructure (CIR) building at the RELIS campus of Texas A&M University System.

impact analyses integrated into GIS framework; Synchrophasors and synchronized sampling technology for Transmission & Distribution applications; Flexible loads including on-site energy storage and distributed generation at different scales; Renewable forecasting with focus on solar and wind generation.

Smart Grid Center founded in August 2012

This year the focus was on developing strategic projects, testbeds, continuing Center-funded projects partially based on its membership with companies, and hosting webinars.

New Large Research Projects

“Empowering Prosumers in Electricity Markets Through Market Design and learning”, PI: S. Shakkottai, Co-PI: L. Xie (ECE, TAMU), V. Subramanian (Univ. Michigan), S. Bose (Univ. Illinois). NSF CPS Medium, \$1.2M, 3 years started in Sep.2020.

“Multi-layer Cybersecurity and Situational Awareness to Enhance Resiliency in Qatar’s Power Grids”, Lead PI: H. Abu-Rub (EE TAMU-Qatar), Co-PIs N. Reddy (ECE TAMU) et al., Partners include Qatar University, TAMU, TAMU-Qatar, Kansas State University, University of Illinois at Chicago, Kahramaa, Hamad Bin Khelifa University. QNRF awarded \$3.2M to the project for 4 years starting in Jan. 2021.

“Real-Time Learning and Control of Stochastic Nanostructure Growth Process Through in Situ Dynamic Imaging”, NSF CPS: Medium, PI: Y. Ding, Co-PIs: J. Hu and P.R. Kumar (ECE, TAMU), \$1,215,737, 3 years, started in Jan. 2021.

Advisory Board Meetings

- The 17th AB meeting was held via zoom on Nov. 9, 2020



From top left to right: Jorge Bermúdez (Chair), Andrea Kishné (Center Admin.), Gary Rackliffe (ABB, Hitachi Energy), Thomas Overbye (Center Dir.), Cameron Smallwood (UCS), Le Xie (ECE), Danielle Merfeld (GE), Miroslav Begovic (Assoc. Center Dir.), Bill Abler (Entergy), Bill Magness (ERCOT), Valentine Emesih (CNP), Khaili Shalabi (LCRA), Jennifer Curran (MISO), Cris Eugster (CPS Energy), Narasimha Reddy (TEES)

- The 18th AB meeting was also held via zoom on Apr. 5, 2021.

New Advisory Board Member

Mr. Valentine Emesih, Division Vice President, CenterPoint Energy, joined the Advisory Board and started his 3-year term on Jan. 2021

The list of all current Board Members can be found at <https://smartgridcenter.tamu.edu/index.php/advisory-board>

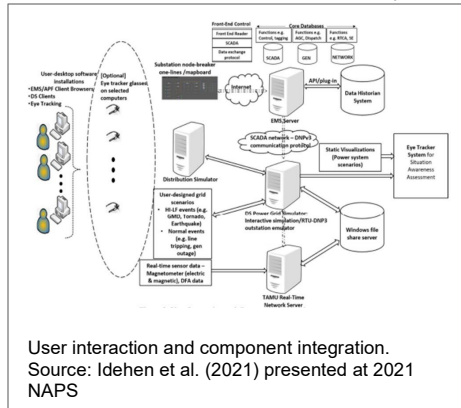
Short Courses

The short courses were held via zoom

- “Data Science and Machine Learning for Modern Power Systems”, Course director: L. Xie (ECE TAMU). Dec. 1-3, 2020. Later this course became available as video for a self-pace course with remotely offered office hours included.
- “Machine Learning and Deep Learning for Smart Grids Big Data, Short Course”, Course instructors: Dabeeruddin Syed; Ameema Zainab (PhD candidates, ECE, TAMU), Free for SGC-Q partners, Apr. 4, 2021.

Testbeds

- Large-Scale Electric System Research Center (PI: T. Overbye):
 - supporting research in electric system planning, operations and performance;
 - serving as an educational platform to support university courses and industry short courses;
 - providing a comprehensive platform for the industry to perform commissioned studies and analyses.



- Resilient Energy Systems Lab (RESLab, PI: K. Davis) enabling Cyber-Physical Resilient Energy Systems (CYPRES) for modeling, developing use cases and with closed loop of monitoring analysing, controlling, and evaluating. CYPRES was created to act as a next generation cyber-physical EMS/SCADA. More is posted at <http://cypres.engr.tamu.edu>

Webinars Held via Zoom

- “Enabling Power System Cyber-Physical Resilience”, Presenter: K. Davis (ECE TAMU), Sep. 23, 2020.
- “Recent Developments in Geomagnetic Disturbance Analysis and the Texas Magnetometer Network”, Presenter: K. Shetye (ECE TAMU). Oct. 28, 2020.
- “Techniques for Designing Large Transmission Networks in Synthetic Electric Grids”, Presenter: A. Birchfield (Electric Power Research Institute), Dec. 22, 2020.
- “Cyber-Physical Resilient Energy Systems: A Secure Foundation for Next-Generation Energy Management”, Presenter: K. Davis (ECE TAMU), Jan. 14, 2021.
- “Assessment of an AC Interconnection of the North American Eastern and Western Electric Grids”, Presenter: T. Overbye (ECE TAMU), Feb. 24, 2021.
- “Improving the Reliability and Health of Distribution Circuits Using Real-Time Diagnostics and Incipient Failure Detection Preventing Outages, Fire Ignition and Safety Hazards”, Presenters: B. D. Russell, C. Brenner, J. Wischkaemper, and K. Manivannan (ECE TAMU), Mar. 31, 2021.
- “Coupled Infrastructure Modeling of Electric Grid and Transportation Networks” Presenters: A. Xu (TTI) and K. Shetye (ECE) re-scheduled from Apr. 28, 2021, to May 5, 2021.
- “Demystifying Electric Grid Modal Analysis” Presenter: T. Overbye (ECE), Jun. 2, 2021.

Publications

- Research results were published in 17 peer-reviewed papers, 1 patent, and 13 conference publications by SGC faculty collaborators (as first authors) at SGC.
- SGC-Qatar faculty, staff, and students published (as first authors) 35 peer-reviewed papers, and 31 conference publications.

Selected publications can be downloaded at the Center’s websites.

SGC Websites

Expertise of collaborating faculty members, news on activities, selected publications and more can be viewed at <http://smartgridcenter.tamu.edu>.

For the SGC-Q, news and information on people, projects and publications are posted at <http://www.sgc-q.com>.