that sustained power interruptions impose on the U.S. economy [38]. By enabling reliable, cost-effective microgrid deployment across the 16 critical infrastructure sectors identified by the Department of Homeland Security [39], this technology directly enhances national economic resilience while creating substantial employment opportunities. Conservative industry projections indicate that microgrid market expansion could generate up to 500,000 jobs by 2030, including 435,700 construction positions, with wages comparable to the broader electrical industry ($62,350-$111,910 median for electricians and electrical engineers, respectively) [40, 41]. The United States currently maintains global leadership with approximately 40% of worldwide microgrid capacity [42], creating significant export opportunities as international markets expand. The vendor-agnostic nature of our approach eliminates the technological lock-in that has limited U.S. competitiveness in global markets, enabling American companies to offer standardized, interoperable solutions that can compete effectively against proprietary systems. This technological advantage, combined with the Department of Energy's strategic vision that "microgrids are essential building blocks of the future electricity delivery system" [43], positions the United States to capture substantial portions of the global clean energy technology export market while strengthening domestic energy infrastructure resilience across critical sectors including healthcare, emergency services, research institutions, and defense facilities.

American STEM Workforce Development and Broadening Participation: This project creates transformational educational impacts by developing American STEM talent through undergraduate research opportunities focused on emerging technologies at the intersection of artificial intelligence, control systems, and clean energy. Our Kern County location provides unique opportunities to engage women and individuals from underrepresented groups in hands-on research that directly addresses regional energy challenges while building skills applicable to high-growth technology sectors.

The comprehensive research experience spans multiple STEM disciplines—power systems engineering, machine learning, optimization theory, and cyber-physical systems—creating educational pathways that bridge traditional engineering with cutting-edge computational sciences. Undergraduate researchers gain direct experience with physics-informed neural networks, distributed optimization algorithms, and real-time embedded systems programming, building portfolios of technical skills highly valued by technology employers and graduate programs. To move results into practice, CSUB's California Energy Research Center (CERC) will coordinate partners and pilots, run demonstrations, manage agreements and permitting, and support student capstones and short, skills-focused training.

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