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AFFORDABLE AND CLEAN ENERGY

2020-2024 Publications	1,038
2020-2024 Percentage of all Taiwan Publications	8.4%
Course Units	186
Student Engagement with Units on SDG 7	2,613

Research

Advanced Energy Materials and Applications

The Advanced Energy Materials and Applications of NYCU's Center for Emergent Functional Matter Science (CEFMS) integrates key solar and hydrogen technologies to convert solar energy efficiently and store it as hydrogen. The research focuses include the development of novel photo/electrocatalytic materials and catalysts to enable solar-powered water splitting for hydrogen, ammonia cracking for hydrogen, and CO_2 reduction to methane and other green fuels. The team is developing large-area, high-performance, next-generation solar cell modules as power sources for photoelectrocatalytic reactions. Focusing on long-term stability, low precious metal usage, and scalable manufacturing processes, they are creating next-generation energy storage and fuel preparation technologies with high conversion efficiency, scalability, and low carbon footprints to support net-zero carbon emissions and clean energy goals.

Frontier Power Electronics Center

The Advanced Power Electronics Center of NYCU's College of Electrical and Computer Engineering focuses on core power electronics technologies for high-efficiency power conversion and power management across applications, including renewable energy, high-efficiency power supplies, motor drives, smart lighting, and battery management. The Center integrates power electronics, microelectronics, automatic control, and power module packaging to develop high-performance power ICs, power modules, and complete systems while building a comprehensive talent pipeline. Dedicated laboratories span power electronics systems and IC design, power-management ICs, battery-management ICs, servo and motion control, and applied power electronics. With five full-time faculty members and over 60 master's and doctoral students, the Center provides robust R&D and training capacity. Through technological innovation and cross-disciplinary integration, it supports industrial upgrading, enhances renewable grid integration efficiency and demand-side energy savings, and advances sustainability goals in clean energy and industrial innovation.

Social Impact

Tang Prize Master Forum Highlights Breakthroughs in Energy Materials

Co-hosted by NYCU and Taiwan's Industrial Technology Research Institute (ITRI), the Tang Prize Master Forum featured Prof. Omar M. Yaghi, the 2024 Sustainable Development Laureate, who presented frontier advances in metal–organic frameworks (MOFs) and covalent organic frameworks (COFs). The forum underscored how MOFs/COFs—with their ultrahigh surface areas and designable pore architectures—can enable high-density, safe storage of hydrogen and methane, thereby improving the feasibility of renewable energy in transport and end-use applications. Coupled with CO_2 capture, these materials support a dual-axis decarbonization pathway that lowers the carbon footprint of fossil fuel use while accelerating clean energy deployment. Looking toward 2050 net zero, the discussants explored AI-driven material design and how to align Taiwan's manufacturing and scale-up capabilities to accelerate commercialization. The forum linked world-class science with Taiwan's engineering strengths to chart clear technical and collaborative routes for achieving clean energy.

Fusion R&D and Talent Hub

Our university has partnered with Alpha Ring Clean Energy to establish a nuclear fusion laboratory (its fourth globally) on the Guiren Campus in Tainan. Together, they are fostering a "nuclear fusion ecosystem" to promote technological research and development, education, and industry implementation. Alpha Ring has implemented the world's first Alpha-E nuclear fusion education system (integrated hardware, software, curriculum, faculty, and consulting) to support teaching and practical application of deuterium-tritium and hydrogen-boron reactions, cultivating the next generation of nuclear fusion and advanced energy professionals. The laboratory will focus on nuclear fusion module and system design, technology transfer, and commercialization. Through workshops and cross-disciplinary projects, the laboratory will strengthen clean energy R&D capabilities, expand talent supply, and enhance international connections, providing long-term momentum for Taiwan's energy transition and its sustainable development.

Education & Cultivation

Cross-Disciplinary Innovation across Theater, Energy, and Food

As part of the NYCU X Cross-Disciplinary Lecture Series, the founders of 8more shared their entrepreneurial journey from cultural and creative industries into technology and food, demonstrating how to embed sustainable energy thinking and business model innovation into product R&D, supply chain management, and brand strategy. Through real-world case analyses, the talk unpacked energy efficiency, low-carbon processes, and circular packaging during industry transformation, while interactive discussions guided students and faculty to see how cross-domain collaboration links technology adoption, market validation and social impact. The event broadened campus perspectives on renewable energy applications and industrial sustainability, strengthened innovation and entrepreneurship capabilities, and cultivated talent with energy literacy and systems thinking.

Cultivating Talent in Lighting and Energy Photonics

NYCU's Institute of Lighting and Energy Photonics of the College of Photonics is guided by industry needs, and cultivates master's and doctoral-level professionals in lighting and energy optoelectronics, as well as in semiconductor manufacturing processes. Research focuses on three key areas: high-efficiency energy-saving lighting technology, high-efficiency solar cells, and novel optoelectronic materials and advanced device technology.

The curriculum spans organic/inorganic optoelectronics, the principles and frontiers of solar cells, thin-film and nano-optics, metamaterials, optoelectronic device physics, and semiconductor lasers with process practicums. Through cross-disciplinary coursework and laboratory training, students build immediately deployable R&D capabilities in high-efficiency energy saving, renewable-energy optoelectronics, and advanced semiconductor devices, forming a complete competency chain from materials and design to process and manufacturing, and supplying high-caliber R&D talent to Taiwan's clean-energy and optoelectronics industries.

Stewardship

Low-Carbon Compute Powered by a Green Data Center

NYCU has launched an AI high-performance computing platform. Coordinated by the IT Services Center, the platform integrates a resource scheduler and management software stack, a high-throughput parallel file system for AI, and a high-bandwidth switching fabric to support elastic multi-GPU cluster workloads, thereby meeting strong cross-disciplinary research demands. The practical benefits are already evident: the College of Electrical and Computer Engineering team reduced the time required to complete the same experiment on the platform from one day to approximately two hours, and with four times the memory expansion, they were able to train a more efficient model. The platform is integrated into the campus's green energy computer lab, reducing energy consumption and carbon emissions through efficient cooling and energy management, while maintaining the university's existing security mechanisms to ensure operational safety.

Smart Microgrid to Strengthen Power Resilience

To achieve both decarbonization and supply resilience, the university is planning and implementing a campus microgrid based on three pillars: conserve, generate, and intelligently dispatch.

- **Conserve:** Annual efficiency projects and equipment renewals, including LED lighting, higher-efficiency HVAC and chillers, lab/data-center power optimization, peak/off-peak scheduling, and lower high-voltage loads, reduce outage risk and curb electricity costs and carbon emissions.
- **Generate:** Rooftops, carports, and suitable building-integrated PV sites have been assessed for grid-tied or self-consumption modes. Coupled with energy storage, the system discharges at peak and charges off-peak to increase renewable self-consumption and stabilize the campus grid.
- **Intelligent dispatch:** An Energy Management System (EMS) integrates smart meters, PV, storage, and critical loads; establishes baselines; provides real-time monitoring and anomaly alerts; and supports schedule-based control with carbon/cost performance tracking—informing equipment replacement and investment decisions.