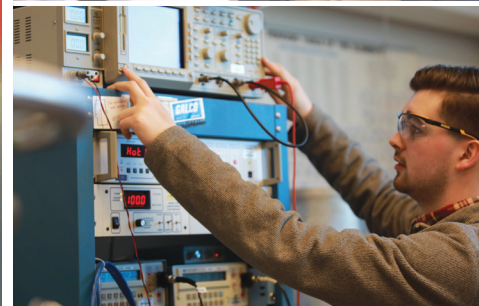
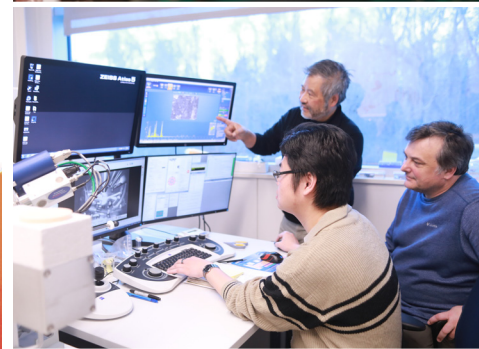
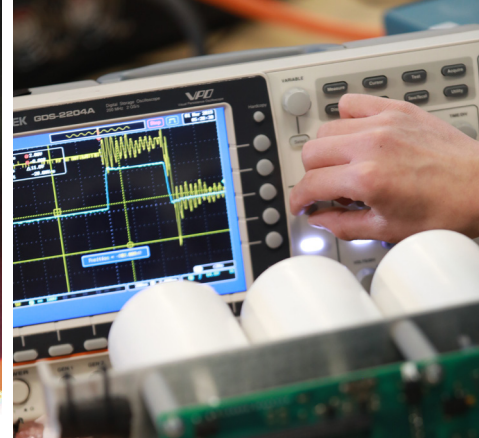




CIEES ANNUAL REPORT 2018



CIEES

**CENTER FOR INTEGRATED
ELECTRIC ENERGY SYSTEMS**

AT STONY BROOK UNIVERSITY

DIRECTOR'S MESSAGE



The **Center for Integrated Electric Energy Systems (CIEES)** is a part of the New York State network of Centers for Advanced Technology and is located at the Advanced Energy Research and Technology Center (AERTC). The CIEES goal is to make New York a global leader in renewable energy technologies, and the integration of renewable sources into the electric grid. CIEES supports collaborations with university experts and Brookhaven National Laboratories in the following thrust domains: electric grid technology, energy storage technology, and integrating storage in the grid.

Dear Colleagues,

2018 was another successful year for CIEES.

Our projects started to deliver a sizeable impact for the New York state economy. Based on our support, **twenty-nine jobs were created and retained** for the participating companies last year. The combined economic impacts, including **new revenues, cost savings and investments, directly related to the CIEES activities, exceeded \$4 M.** Some highlighted achievements are as follows.

In 2018, we expanded our operation into several new areas of expertise of Stony Brook University, including water purification, narrow band semiconductors and marine sciences. With leverage from academic strengths and location of the center, **CIEES has broadened its capability for advancing new technologies to improve the nexus of energy, water and food systems** in New York State and beyond.

Over the last year, **we installed two large energy storage systems at CIEES.** One system was funded by NYSERDA, while the other was provided by a European company that has just relocated to New York. Both projects aim to develop new energy storage solutions to the marketplace. CIEES provided an independent evaluation of the system's performance and demonstrated the system's operation to investors and strategic partners of our clients.

At the 2018 Advanced Energy Conference in New York City, widely attended by the investment community, three CIEES clients featured their technologies in the exhibitions. The Center's strategy is to promote job creation by growing NY-based businesses and by assisting out of state and overseas businesses in relocating to the state. This year's results show that the strategy is working.

Historically, Long Island has had a strong defense industry presence. Until the late 80's, Northrop Grumman was the largest employer in the area, but that changed over time. Long Island's defense businesses possess tremendous human and technological resources to solve the energy and environmental challenges facing the nation. **In 2018, the Center started to work on diversifying select Long Island defense companies.** This activity encompassed market research, re-designing the military products for civilian use and marketing assistance.

Workforce development continues to be our priority in 2018. **Our projects employ over 12 post docs and interns** who acquire valuable hands-on skills that prepare them for the 21st century job market.

In conclusion, 2018 marks a significant broadening of the Center's activities. We are becoming known to the downstate business community as a go-to-place for energy-related technology development and validations.

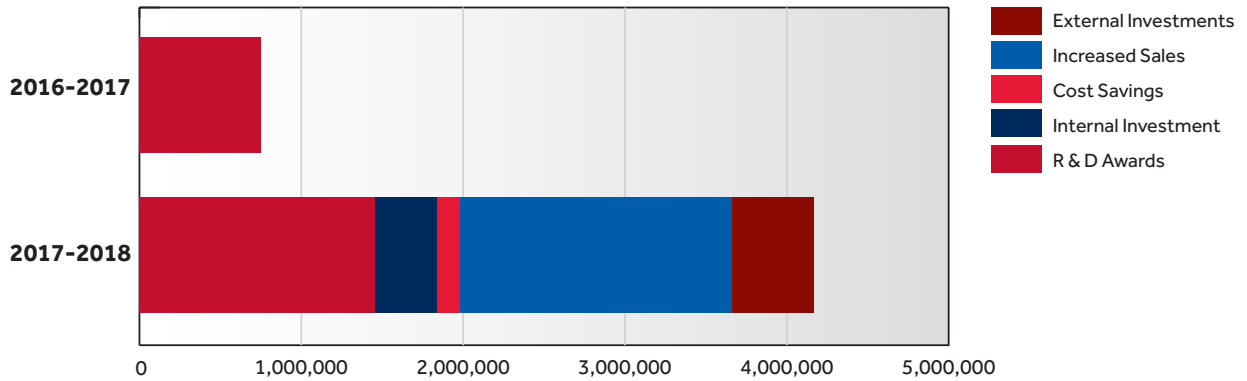
Very Best,

Ben

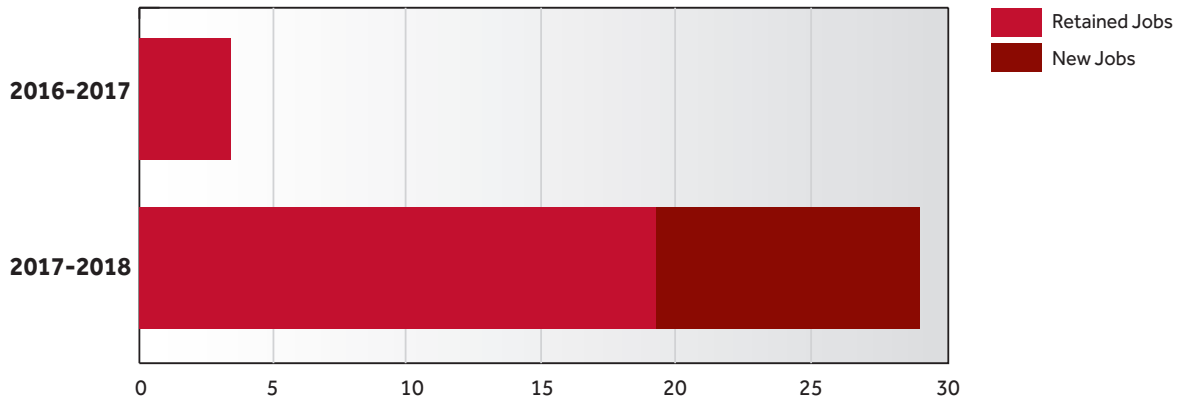
Professor Benjamin Hsiao
CIEES Director

2018 AT A GLANCE

CIEES ECONOMIC IMPACT



JOB CREATION



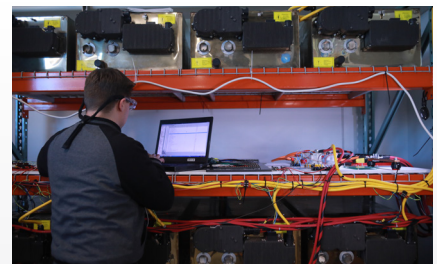
FEBRUARY 2018

The formation of a new Institute of Gas Innovation and Technology (I-GIT), a consortium of industry and academic leaders focused on the development of new energy technologies designed to promote sustainability and save the environment. I-GIT is a CIEES partner in several industrial development projects.



MARCH 2018

CIEES hosted a booth at Advanced Energy Conference 2018. Several of our clients, such as ThermoLift, presented at the industrial exhibition.



APRIL 2018

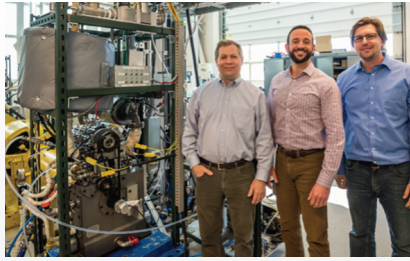
CIEES received and installed 11 molten salt batteries, 200 kWh, as a part of a NYSERDA project focused on evaluation of the technology for areas with seasonal energy demand.

2018 AT A GLANCE



MAY 2018

CIEES was a part of Stony Brook University's delegation at Senator Martin's Golden Tech Expo in Albany, NY.



MAY 2018

A team of researchers from the Department of Mechanical Engineering in the College of Engineering and Applied Sciences, including CIEES research partner Dr. Longtin, won a new two-year \$2.3 million award from the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E). The research involves developing and testing engines powered by internal combustion, such as gasoline or natural gas, and fuel cells.



JUNE 2018

Esther Takeuchi, CIEES faculty partner, one of the world's leading energy storage researchers, and a SUNY distinguished professor in the Department of Materials Science and Chemical Engineering, has won the 2018 European Inventor Award in the category "Non-EPO countries." The European Patent Office (EPO) announced the winners of its 2018 innovation prize at a ceremony in Paris on June 7. Out of four U.S. scientists nominated for the award, she is the only American to bring home Europe's most prestigious prize of innovation.



JULY 2018

The Center for Mesoscale Transport Properties (M2M), was selected to receive a four-year, \$12 million renewal grant from the Department of Energy's Office of Science, to continue its work as a DOE Energy Frontier Research Center. The Stony Brook M2M originally began operations on August 1, 2014, and is housed at the University's New York State Center of Excellence in the Advanced Energy Center in Stony Brook's Research and Development Park.



NOVEMBER 2018

CIEES installed and started testing of a Vanadium flow battery provided by our partner, StorEn Technologies.



DECEMBER 2018

CIEES hosted a trip of Stony Brook University graduate students to a 40 MWh energy storage farm at East Hampton, NY.

PARTNER PROFILES



StorEn TECHNOLOGIES LLC

Project: Evaluation of StorEn Vanadium Flow Battery Technology



StorEn Technologies
Energy you can depend on

Vanadium sulfate flow batteries have long been known as a scalable and inexpensive energy storage solution. However, a typical flow battery installation is comprised of multiple tanks and pumps which need to be plumbed on-site. StorEn developed a complexly sealed flow battery that can be dropped on a customer site and operated immediately. StorEn needed third-party validation of the technology and a test site where the battery solution could be presented to potential customers and invertors. It is critical to demonstrate that the flow battery has the distinct advantage over more entrenched technologies, such as Li-ion. The CIEES team coordinated safe delivery of 1 ton of Vanadium Sulfate electrolyte, filling of the flow battery container, and the installation of the high-current wiring. The battery is undergoing tests.

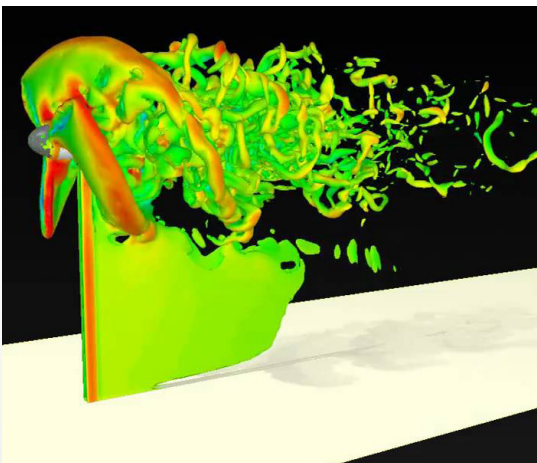


BAH HOLDINGS LLC.

Project: Evaluation of NDIR Gas Sensors



BAH Holdings is a startup company developing optical sensing solutions for the petrochemical industry. The company is interested in developing a new generation of gas sensors using mid-IR lasers and LEDs that are being researched in SBU's Electrical Engineering department. CIEES established a project that utilizes the laser testing facilities at our laser lab. The student evaluated 2nd harmonic lasers and demonstrated detection of both ethane and methane gases. The results are significant, since detection of methane allow the utility to discern a natural gas leak from other sources of methane, such as sewer gas.



GREEN POWER LLC

Project: Green Power Tower Wind Flow Simulation and Design for Improving Energy Efficiency

Green Power Tower (GPT) Energy is a New York, NY based company, which has created a new and efficient vertical axis wind turbine. The turbine incorporates a patented rigid omni-directional structure, which can be of varying sizes and is modular. For this project, CIEES is working with the Mechanical Engineering Department to perform Fluid Dynamics simulation and to improve design of the turbine.

PARTNER PROFILES



AQUA VECTORS INC.

Project: Nitrogen Removal Process Evaluation from Wastewater Treatment



Aqua Vectors Inc develops electrolytic detoxification technology that removes nitrates, phosphates, arsenates, organisms, and pharmaceuticals from water and wastewater. Currently Aqua Vectors technology is targeting nitrates, a common groundwater contaminant in rural areas and fairly reliable indicator of the presence of other contaminants, such as bacteria and pesticides. This development is especially relevant for Long Island, where nitrate levels in aquifers and surface waters have increased at an accelerating rate since 1985. During the project a team of scientists in SBU's Department of Chemistry will evaluate efficiency of electrolytic detoxification in removing nitrates from wastewater.

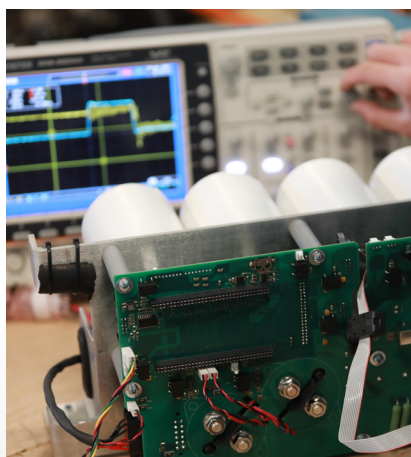


ISLAND PYROCHEMICAL INDUSTRIES (IPI)

Project: Production of Ethyl Cellulose for Energy Applications



The project is focused on synthesis of ethyl cellulose, as well as its characterization and applications as energy materials. The main objective of this project is to optimize the reaction conditions to control the desired quality of ethyl cellulose. To this a team of scientist from SBU's Department of Chemistry set up a high-pressure research reactor. The setup is now producing pilot quantities of ethyl cellulose from renewable and widely accessible natural cellulose. Currently the CIEES-IPG team is working on scaling up the process to pilot production level.



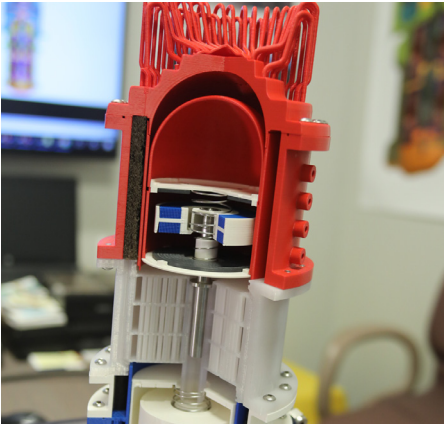
UNIQUE TECHNICAL SERVICES (UTS)

Project: Evaluation of an integrated energy system with molten salt battery energy storage



CIEES, in collaboration with Unique Technical Services (UTS), won a NYSERDA grant for the evaluation of molten salt (ZEBRA) batteries. NYSERDA granted 11 batteries to evaluate applicability of the technology for seasonal energy storage in the Eastern Long Island corridor. The battery packs were installed at the AERTC facility and are currently undergoing evaluation. UTS paired the batteries with their proprietary battery management system which allows running the battery pack more efficiently.

PARTNER PROFILES



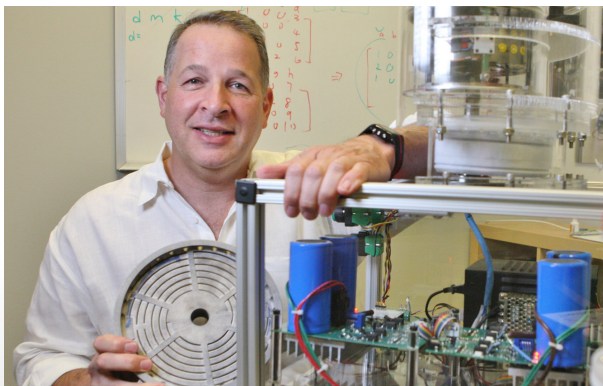
THERMOLIFT

Project: ThermoLift Natural Gas Fired Heat Pump for Building Heating and Cooling



On this project, the CIEES team is working on product development and optimization, which includes designing the whole HVAC system accompanying ThermoLift's heat pump and optimizing it to achieve proposed energy savings.

ThermoLift, based in Stony Brook, NY is developing a cold-climate, natural gas air-conditioner and heat pump technology that combines heating, air-conditioning, and water heating into a single appliance. It can provide a 30-50% reduction in building HVAC costs as well as associated reductions in greenhouse gas emissions. On



Project: Thermodynamic and Kinematic Modeling of ThermoLift Vuilleumier Natural-Gas Heat Pump

ThermoLift is also developing a natural gas air-conditioner and heat pump technology that combines heating, air-conditioning, and water heating into a single appliance. This project will leverage the expertise of Dr. Longtin in thermodynamic modeling of complex heat engines. Specifically, Dr. Longtin's team is optimizing the heat exchanger and the absorber, which can potentially increase the heat pump efficiency by 15%.



NATIONAL GRID

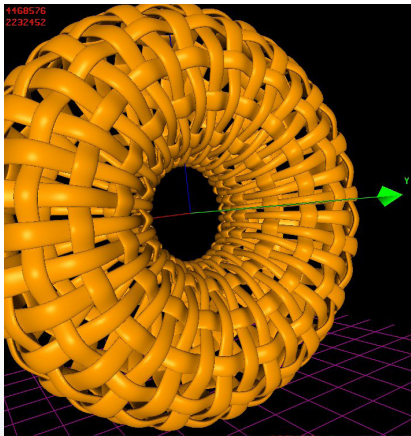
Project: Off-Grid Power Production from Renewable Gas Source



Long Island. The goal is to estimate the impact of renewable gas on Power Production on Long Island. Distributed natural gas generation is considered a viable option for relieving grid strain in congested load pockets, such as the South and North Forks of Long Island. The natural gas generators, working in tandem with renewable energy sources, offer an economic alternative to chemical energy storage in some load pockets. The CIEES team, led by Dr. Devinder Mahajan, Director of Institute of Gas Innovation and Technology (I-GIT), identifies hybrid gas sources based on off-grid technologies for distributed power production.

The CIEES team is evaluating the market and technology for distributed energy generation using gas on

PARTNER PROFILES

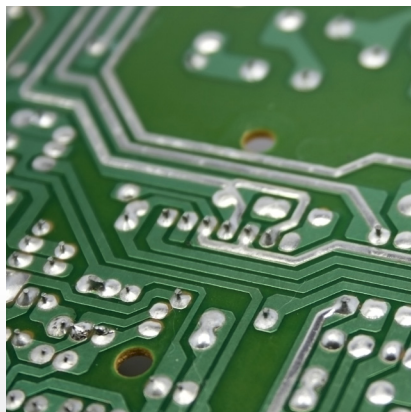


OMNITEK PARTNERS

Project: Harvesting from CNC Machines



Omnitek Partners is an innovative small business focused on the development of advanced technology and products. Since 2000, Omnitek Partners has been devoted to solving problems for clients within the military, medical, and commercial marketplaces. The CIEES team is working on the development of energy harvesting micromachines that would find applications in sensors, autonomous robots, and surveillance systems. The work is focused on mathematical modeling of the harvester and optimization of the design.



CHEMCUBED

Project: Evaluation of additive manufactured composites for energy applications



ChemCubed is a fast-growing company in the advanced composites field. This project is focused on developing new metal ink formulations for printing flexible electronic circuits. The improved ink has a significant cost advantage over competing products. Currently, the company is actively marketing printed electronic tags and RFID's for security, logistics and retail applications.



ECO2HEAT

The main goal of this project is assisting the small company Eco2Heat in obtaining UL certification of their far infrared heating wall panels. The project is in the completion stages. Several panel types have been examined by the UL branch in Melville, NY, minor changes have been made by the company according to the results of the preliminary examination, and the modified panels will undergo the final testing at the UL facility. Theoretical analysis of the panels showed significant (up to 30%) reduction of CO₂ emissions if the panels are used in a smart home environment.

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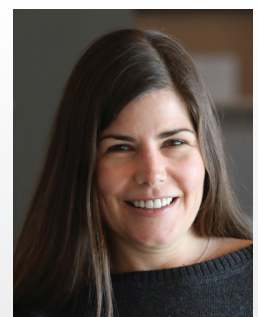
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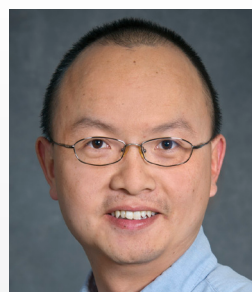
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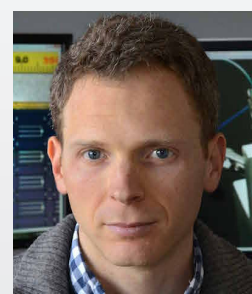
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The CIEES goal is to make New York a global leader in technologies that will accelerate the progress of renewable energy as one of the mainstream resources displacing fossil fuel-based electric power worldwide by facilitating the integration of renewable sources into the electric grid.

CIEES will promote industry growth in New York by supporting industry collaborations with university experts in the following domains:

CHEMISTRY AND MATERIALS

ENERGY GENERATION AND ENERGY POLICY

SEMICONDUCTORS AND ELECTRONICS

INFORMATION TECHNOLOGIES AND BIG DATA

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