

# CIEES ANNUAL REPORT 2017



**CIEES**

**CENTER FOR INTEGRATED  
ELECTRIC ENERGY SYSTEMS**

**AT STONY BROOK UNIVERSITY**

# DIRECTOR'S MESSAGE



Dear Colleagues,

2017 was an exciting year for the center.

During our second year in operation, **CIEES started seven new projects with NY companies**, addressing technologies ranging from synthetic fuels to additive manufacturing and energy storage. All of these activities shared one common goal: realizing our vision of Long Island as the 'Valley' of renewable energy and smart grid.

As renewable energy sources continue to penetrate the traditional grid, new sets of technological challenges continue to emerge: economical storage of large amounts of energy, managing variable electric loads, and cybersecurity of the grid. **Our area of operation, Eastern Long Island, is the ideal testbed for new energy technologies**, as our large population density, high land cost and large swings of seasonal power consumption drive the demand for out-of-box energy solutions. Our first CIEES workshop, held in October 2017 at Stony Brook University Technopark, pulled together small businesses, energy utilities and academics from NY State, and enabled the workshop team to outline a practical roadmap towards the renewable energy future of downstate NY.

We enter 2018 with a new crop of energy projects aimed at demonstration of value of large scale in-grid energy storage technologies for NY communities. **We will be taking continued strides towards elevating CIEES as a hub of energy and grid innovation.**

Very Best,  
*Ben*

Professor Benjamin Hsiao  
CIEES Director

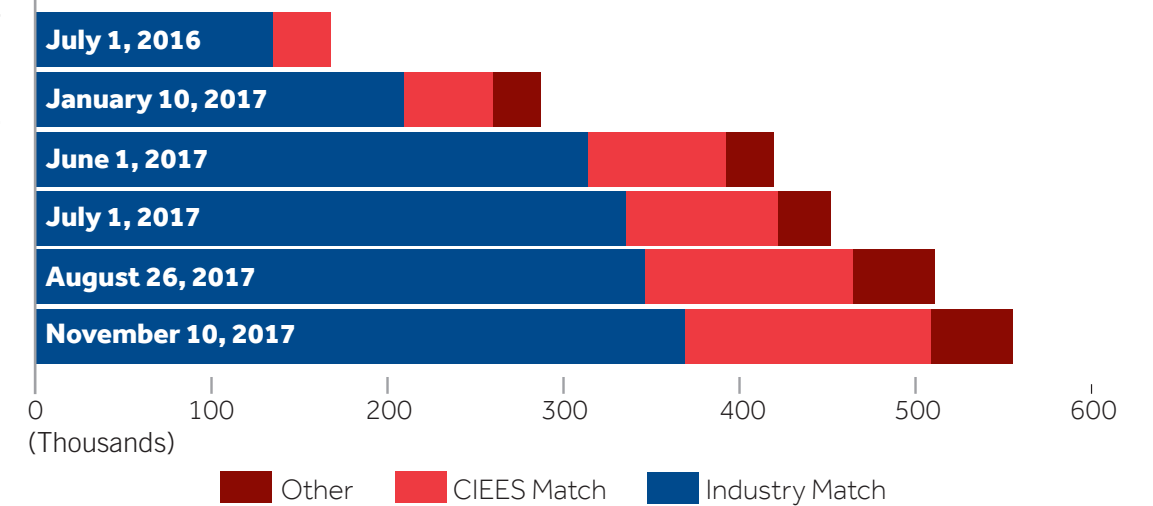


The **Center for Integrated Electric Energy Systems (CIEES)** is a part of the New York State network of Centers for Advanced Technology and is located at the Advanced Energy Research and Technology Center (AERTC). The CIEES goal is to make New York a global leader in renewable energy technologies, and 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.

# 2017 AT A GLANCE

## ECONOMIC IMPACT

2016-2017  
Cumulative  
Budget



## EDUCATIONAL IMPACT

- 6 SBU undergraduate students engaged in the industry projects
- 3 post-doctoral research associates
- 3 graduate students
- 1 workshop

# PARTNER PROFILES



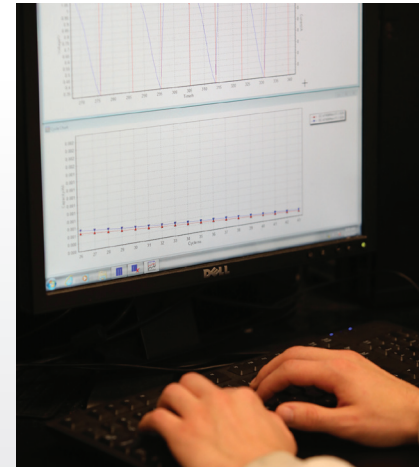
## UNIQUE TECHNICAL SERVICE LLC

**Unique Technical Service (UTS) is a small business specializing in development of power electronics for hybrid vehicles and the electrical grid.**

**Project: Evaluation of liquid salt (ZEBRA) batteries as seasonal energy storage solution for Long Island South Fork region**

South Fork of Long Island (SFLI) is a high-density residential area facing power shortage in coming years. Due to large summer population, the electricity demand has a distinct seasonal pattern. The annual average power demand is 55 MW, however the summer month demand is 95 MW on average, reaching values as high as 140 MW for 10-20 hrs. In this project, the CIEES-UTS team is evaluating liquid salt (ZEBRA) batteries as an energy storage solution for the South Fork region. ZEBRA batteries offer

low-cost energy storage that is better suited for an area with distinct seasonal energy demands. The battery normally operates at 300°C, when cooled to the ambient temperature it can be stored indefinitely. A battery farm would be activated during summer months only, thus requiring no off-season maintenance.



## ENERGY IT

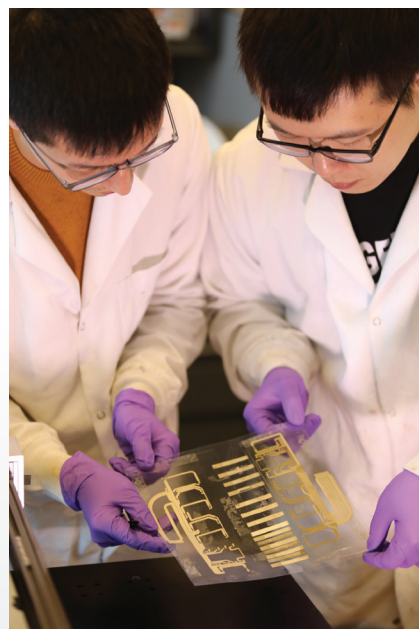
**Energy IT is a small business developing predictive digital models for electric grid utilities.**

**Project: Predictive digital model of the electrical grid**

The CIEES team, led by Prof. Eugene Feinberg, is developing a predictive digital model of the electrical grid.

The team will design and develop a meter and data management system that will eventually be integrated into the larger energy management system. The model will also include medium and long-term load forecasting features, which use time-series analysis and/or methods of artificial neural networks, and integrate them into the previously developed short-term load forecasting system.

During the project the team will also conduct research and development of fast service restoration models and algorithms for electric distribution systems. The team will integrate the previously developed fault detection and location models and the developed models and algorithms into the existing energy management platform.

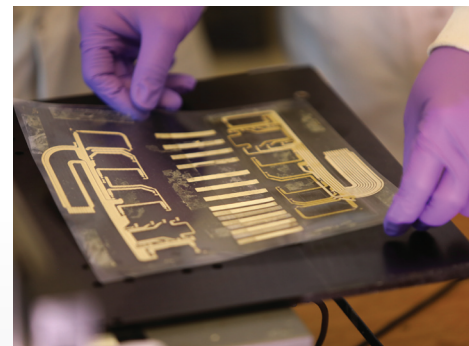


## CHEMCUBED

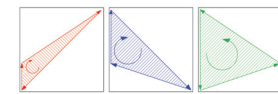
**ChemCubed is developing and manufacturing inks and coatings for flexible electronics and printing.**

**Project: Evaluation of additive manufactured composites for energy applications**

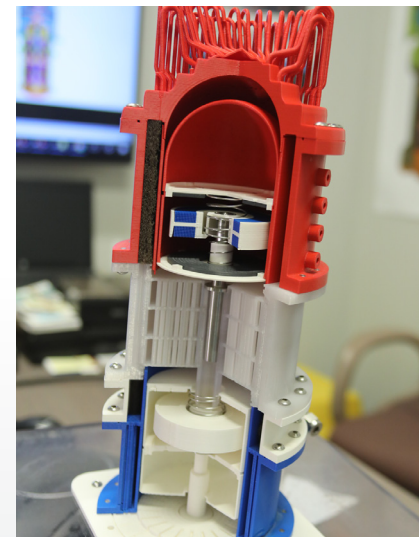
Composite materials and methods of additive manufacturing are provided for producing composite materials with precisely-controlled properties. Examples of properties that can be precisely controlled in the composite material include hardness, tensile strength, elongation at break, flame retardancy etc. In various aspects the methods can include printing amounts of two or more curable liquids from a multichannel piezo head device to form a layer that can be cured by applying a wavelength of light from a light source. Preparing and testing of these materials is needed for commercialization.



The CIEES team works with ChemCubed on evaluation of the advanced composites using the equipment available at the CIEES facility and the Composite Center.



ThermoLift, Inc.



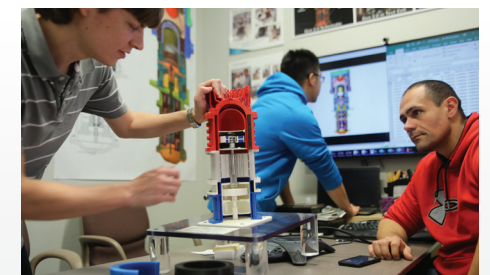
## THERMOLIFT INC.

**ThermoLift 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.**

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

This project will focus on studying thermodynamic and kinematic performance of the Vuilleumier natural-gas heat pump developed by ThermoLift, Inc. The advantage of the ThermoLift design is that the same device can be used for both heating and cooling. By using natural gas, the device can take load off the electrical grid during the summer months. ThermoLift uses the expertise of SBU's Department of Mechanical Engineering to model kinematic performance of the machine, and identify design improvements.

The improved machine can provide a 30-50% reduction in building HVAC costs as well as associated reductions in greenhouse gas emissions.



# PARTNER PROFILES



## ISLAND GROUP ENTERPRISES

**Island Group Enterprises (IGE) is a Long Island chemical company. IGE develops specialty chemicals and polymers that use renewable feedstock.**

**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 end, a team of scientists 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.

These materials can be used for a wide range of energy applications, including propellants for the rapidly developing private space launch industry. Another

example application is the development of polymers for solar holographic devices, an electricity generator that uses inexhaustible and sustainable solar energy.



## NATIONAL GRID

**National Grid is one of the largest investor-owned energy companies in the world - covering Massachusetts, New York, Rhode Island and the UK. The company is delivering clean energy to support our world long into the future.**

**Project: Off-Grid Power Production from Renewable Gas Source**

The CIEES team is evaluating the market and technology for distributed energy generation using gas on Long Island. The goal is to estimate 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 the Institute of Gas Innovation and Technology (I-GIT), identified hybrid gas sources based on off-grid technologies for distributed power production. Specifically, 20kW skid-mounted systems are the optimum solution for distributed power generation.

# OUR FACILITIES



## MALVERN: GEL PERMEATION CHROMATOGRAPHY (GPC)

Gel permeation chromatography (GPC) is a type of size exclusion chromatography (SEC), that separates analytes on the basis of size. The technique is often used for the analysis of polymers. It is often necessary to separate polymers, both to analyze them as well as to purify the desired product.



## GENESYS: UV-VIS SPECTROPHOTOMETER

UV-Vis spectrophotometer is a high sensitivity, high resolution, low stray light instrument for transmission and absorption measurements of powder, thin films, solid and liquid samples.



## COLLOIDAL DYNAMICS: ZETA PROBE

The ZetaProbe is the easiest to use, most accurate zeta potential analyzer available. Samples can be measured without dilution or sample preparation at concentrations up to 60% volume. Even the direct measurements of pastes, gels, cements, and other difficult materials are possible with the ZetaProbe.



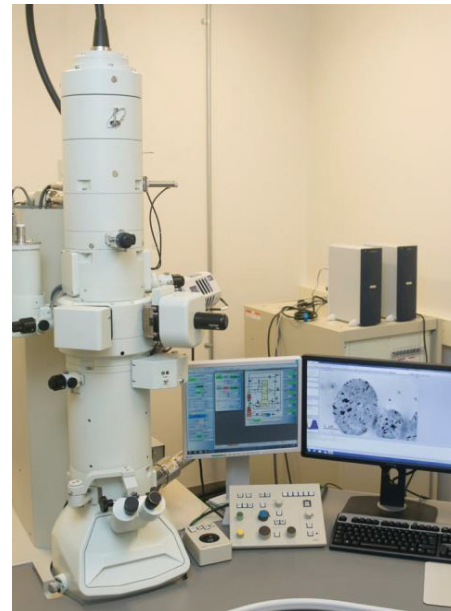
## QUANTACHROME: SURFACE AREA ANALYZER

Surface area analyzer is a very sensitive technique to find out the surface area, size, shape and volume of the pores. It is also useful to calculate the catalytic activity of the solid catalyst.

# OUR FACILITIES

## JEOL JEM 1400: TEM

TEM utilizes energetic electrons to provide morphologic, compositional and crystallographic information on samples. At a maximum potential magnification of 1 nm.



## TA Q800: DYNAMIC MECHANICAL ANALYZER

Dynamic mechanical analysis is a technique used to study and characterize materials. It is most useful for studying the viscoelastic behavior of polymers.



## RIGAKU MINIFLEX: POWDER X-RAY DIFFRACTOMETER

X-ray powder diffraction is most widely used for the identification of unknown crystalline materials (e.g. minerals, inorganic compounds). Determination of unknown solids is critical to studies in geology, environmental science, material science, engineering and biology.



# OUR FACILITIES

## THERMO FISHER SCIENTIFIC: ATR-IR SPECTROMETER

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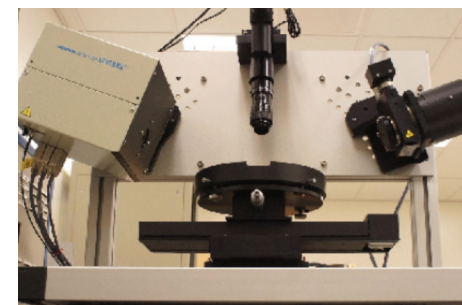
## PERKIN ELMER: TGA-DTA TA INSTRUMENTS

The Dimond (TG/DTA) combines the high flexibility of the differential temperature Analysis (DTA) feature with the thermogravimetric measurement. The combination ensures that sample is exposed to identical thermal treatment and allows one to identify exothermic or endothermic transition associated with expected transition.



## HORIBA UVISEL FUV: ELLIPSOMETER

Ellipsometry is an optical technique for investigating the dielectric properties (complex refractive index or dielectric function) of thin films.



## BRUKER DIMENSION (ICON): SEM

The SEM is routinely used to generate high-resolution images of shapes of objects (SEI) and to show spatial variations in chemical compositions.



# ADVISORY BOARD



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National Grid New York



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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 thrust domains:

**ELECTRIC GRID TECHNOLOGY  
ENERGY STORAGE TECHNOLOGY  
INTEGRATING STORAGE IN THE GRID**



# CIEES

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