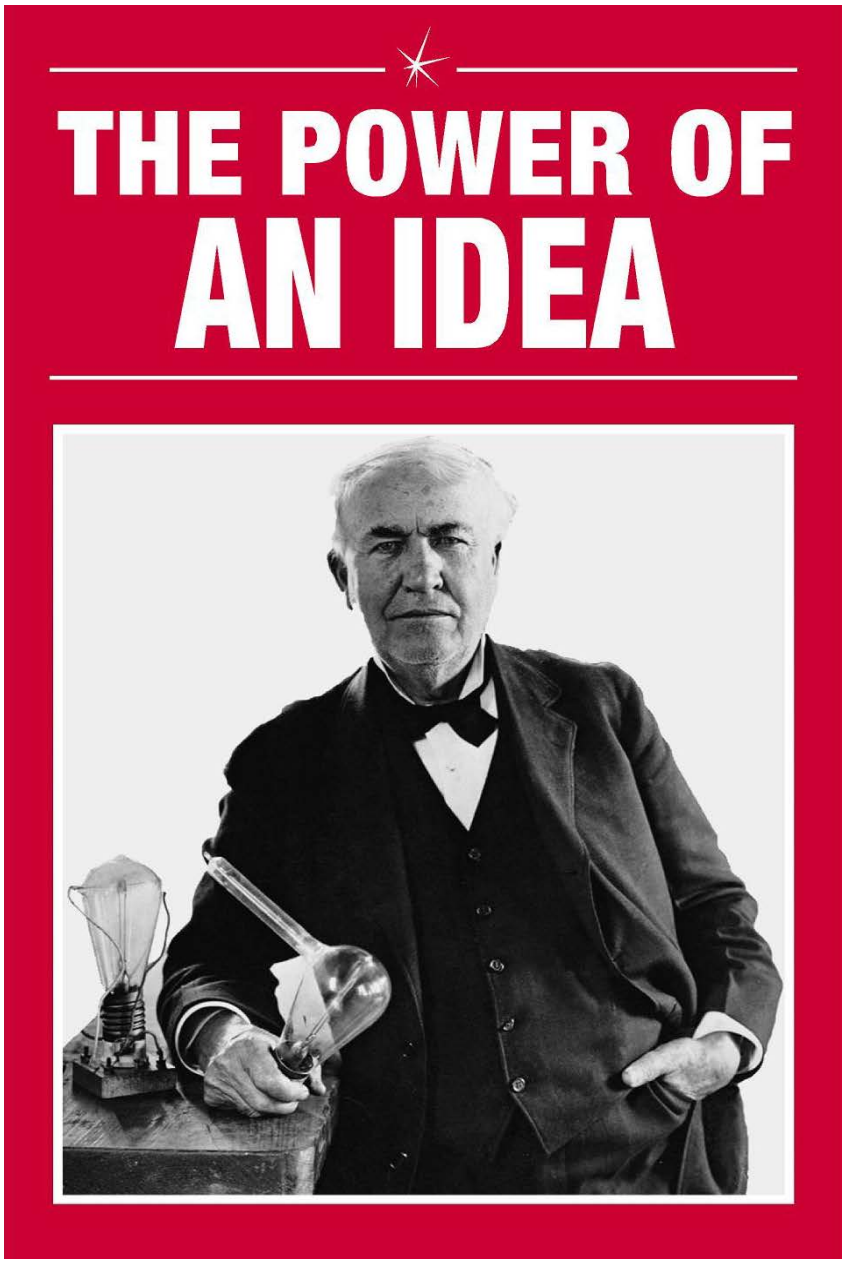
Smart Grid Advanced Metering Annual Implementation Progress Report

ATTACHMENT 3

Test Bed / Technology Demonstrations

ComEd
An Exelon Company

Commonwealth Edison Company's Quarterly Smart Grid Test Bed Report



February 12, 2016

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I. Introduction

Pursuant to subsection 16-108.8 of the Public Utilities Act ("Act"), ComEd created its Smart Grid Test Bed ("Test Bed"). ComEd's Test Bed objectives support the objectives set forth in Section 16-108.8 of the Act. In addition, ComEd will protect the safety and security of its distribution grid and grid operations through the Test Bed Idea ("Idea") selection process, and management of Test Bed Demonstration ("Demonstration") projects.

ComEd's Test Bed mission is to facilitate and provide open and unbiased live-grid opportunities for testing, demonstration, and promotion of innovative Smart Grid programs, technologies, business models, services, products, and other Smart Grid-related activities that may benefit ComEd's customers.

ComEd's Test Bed vision is focused on providing innovative ways to demonstrate, in an open and unbiased manner, how working technology actually operates in a live utility scale environment. The Test Bed is not intended to provide a lab where investigational ideas are tested out; those facilities exist and such tests are not appropriate for a live environment. The Test Bed allows approved Idea Submitters ("Submitters"), subject to appropriate protections, to connect technology to the utility grid for the purpose of demonstrating that the technology functions as designed. The Test Bed is designed to help validate business models or services by permitting demonstration of specific functional aspects of the technology and/or verification that services/business models provide the intended results.

The Test Bed is open to all qualified Idea Submitters. ComEd envisions a diverse group of qualified Idea Submitters that may consist of scientific, technical, entrepreneurial, innovative, and non-technical Idea stakeholders. Ideas may come from a variety of sources including, but not limited to: the Illinois Science and Energy Innovation Trust ("Energy Foundry"), ComEd's own employees, professional organizations, universities, entrepreneurs, technology partners, and other ComEd stakeholders. By opening the Test Bed to a diverse group of stakeholders, ComEd will provide live-grid opportunities to as many Test Bed Demonstrations as reasonably feasible.

Accordingly, this report summarizes the Test Bed activities, discoveries, and other information deemed mutually relevant from October 1, 2015, through December 31, 2015 ("Reporting Period") as described in subsection (i) of Section 16-108.8 of the Act.

II. Test Bed Ideas

ComEd has led existing and new Test Bed Idea coordination activities during the current Reporting Period. Test Bed Idea status updates are provided in the following three categories: Potential Test Bed Idea Submissions, Submitted Test Bed Ideas, and Previously Submitted Test Bed Ideas.

Stage of Development Symbols

New Idea Stage: Ideas are received and an initial review is conducted to seek clarification on the Idea and to determine applicability of the technology for the Test Bed and for the ComEd system.

Analysis/Planning Stage: Internal subject matter experts work closely with the Idea Submitter to develop a Demonstration Plan, which includes the Demonstration objectives and key functions of the technology to be tested, as well as the scope of work ("SOW"), associated costs, and success metrics.

Demonstration Stage: The technology is installed/constructed, and demonstrated on ComEd's grid in accordance with the Demonstration Plan and/or Test Bed Agreement.

Potential Test Bed Idea Submissions

Aetna Insulated Wire

Aetna Insulated Wire has a modular cable protection system that is customizable for various electric power distribution and fiber optic cables. Aetna's SafeGuard System offers critical circuit protection against a variety of threats including insulated, cut-resistant cable, EMP shielding (natural and man-made) and signal security, protection against small-scale intentional electromagnetic interference (IEMI) devices, and ballistic deterrence. Aetna has expressed interest in the Test Bed and has initiated discussions for a potential Test Bed Demonstration. As discussions continue, further evaluation will be conducted to determine if Aetna's cable protection system meets the criteria and spirit or intent of the Test Bed.

General Electric Lighting

General Electric is proposing to install various security technologies with applied analytics in a ComEd substation. This pilot will also aid by retrofitting aging high-pressure sodium lighting with LED lighting.

Qualitrol Corp.

Qualitrol Corp. has various smart sensing technologies that monitor pole tilt with battery-powered and wireless communications, monitor optical vibrations, vectors and displacement for transformer and circuit breakers, and monitor optical voltage and current. Qualitrol has expressed interest in the Test Bed and has initiated discussions for a potential Test Bed Demonstration. As discussions continue, further evaluation will be conducted to determine if Qualitrol's smart sensing technologies meet the criteria and spirit or intent of the Test Bed.

Semtive

Semtive proposed a Test Bed Idea Submittal for a renewable energy technology, the Nemoi, a vertical wind turbine. The turbines can be installed on street light structures or upon rooftops. Semtive currently has three 3-phase models: XS (12V; 100W nominal power; average 200KWh/year); S (24/48V; 200W; 350KWh/yr); and M (24/48V; 1KW; 2,5MWh/yr). Semtive is proposing a Test Bed Demonstration for its S-model and M-model, targeting Q1 2016 for US manufacturing of existing models and mid-2016 for development of new L and XL models. Semtive has expressed interest in the Test Bed and has initiated discussions for a potential Test Bed Demonstration. As discussions continue, further evaluation will be conducted to determine if Semtive's renewable energy technology meets the criteria and spirit or intent of the Test Bed.

Southwire

Southwire has been working with Electric Power Research Institute (EPRI) to develop a suite of substation sensors. The proposed technologies pose an integrated solution

using a base station, i.e., a Southwire Gateway, to collect weather data and data from multiple sensors and to communicate that data to the local utility. The communication uses a process control network (PCN) to transmit via a cellular network or direct wire to SCADA. The family of sensing technologies Southwire is proposing includes a Line Monitor, a Connector Monitor, and an Insulator Monitor. For example, the Insulator Monitor (porcelain, glass and polymer) senses contaminate deposit and build-up, and records temperature, humidity, rain, and wind speed and direction data. The sensor will send an alarm/notification (via 2.4 GHz RF) when the equipment requires maintenance before a flashover due to leakage current caused by moisture or contamination. Southwire has expressed interest in the Test Bed and has initiated discussions for a potential Test Bed Demonstration. As discussions continue, further evaluation will be conducted to determine if Southwire's substation sensor technologies meet the criteria and spirit or intent of the Test Bed. Southwire is targeting a potential Test Bed Demonstration for late 2016.

Submitted Test Bed Ideas

eluminocity US Inc.

In collaboration with the Illinois Institute of Technology ("IIT") and Silver Spring Networks ("SSN"), eluminocity will be piloting their Light & Charge system, a combined smart LED streetlight and electric vehicle charging unit, which Eluminocity developed in cooperation with automaker BMW. A smart wireless connectivity platform is integrated to allow for sensor-based applications such as lighting control based on occupancy or real-time parking space monitoring. The proposed unit for IIT,

which was on display at CES 2016 in Las Vegas, will be a new installation in the parking lot at IIT. However, further applications can ideally be retrofitted to existing streetlights, thereby significantly lowering the costs of installation when compared to conventional EV charging stations. The luminaries are compatible with existing infrastructure and can be sized accordingly, with up to four LED modules per luminaire, further reducing energy consumption.

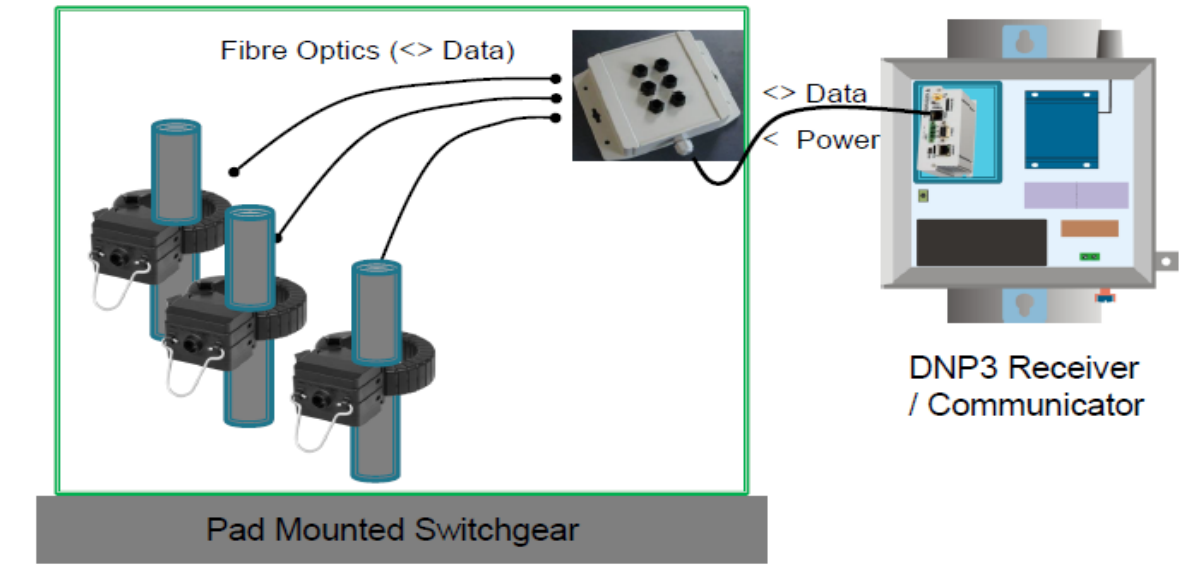
Previously Submitted Test Bed Ideas

Rabine Group

The Rabine Group has proposed an Idea to demonstrate its Maximum Power Transfer Solution (MPTS). The MPTS decreases overall electrical power consumption and improves electrical power quality using dynamic impedance matching technology. Rabine uses an independent monitoring system with its MPTS technology. The MPTS precisely senses the supply input and demand output, matches the impedance parameters, adjusts the resonance of the resulting network loop and synchronizes and optimizes the output. This occurs at very high speeds in the device eliminating nearly all the wasted electrical power in the system thereby decreasing the carbon footprint and improving energy availability at the facility. This reduces total electrical consumption by significant levels and enhances electrical efficiency (power factor) of the network to near unity. Rabine's MPTS technology Idea is currently under review and consideration as a Test Bed Demonstration.

Power Delivery Products (“PDP”)

PDP proposed a Demonstration of a “Smart Load Tracker” fault detection solution that PDP is currently developing for underground pad-mount applications.



A key feature of this technology is its capability to provide remote notification via ComEd’s two-way wireless mesh network. The solution is designed to cost-effectively reduce customer outage response times and is particularly applicable for underground direct buried cable “loop schemes”, which can include up to pad-mount transformers and cable sections. The Smart Load Tracker solution provides intelligent identification and real-time reporting of underground cable faults, as well as information to improve ongoing monitoring of distribution lines. A key capability proposed to be demonstrated in the Test Bed is real-time notification of cable faults and communications via the Silver Spring communications network. After scoping discussions were held in Q1 of 2015, PDP is exploring further innovations to better align the Smart Load Tracker solution with the application scenarios discussed for single-phase underground

residential distribution ("URD") loops to utilize single-phase pad-mounted transformers. PDP is targeting Q1 2016 to have single-phase communication units available for pad-mounted transformers. The Demonstration Plan is expected to be finalized when PDP has single-phase communication units available.

Athena Power, Inc.

Athena Power, Inc. proposed an Idea on a next generation sensor for real-time underground remote monitoring and fault detection. The sensor is self-powered, weather-proof, and can communicate to an external radio via DNP3 protocol. The sensor can be used for subsurface or pad-mounted transformers or switchgear, sectionalizing cabinets, junction boxes, and splices. Athena's submitted Idea has been reviewed. It has been determined Athena's Test Bed Idea is a potential Test Bed Demonstration project, pending execution of a Test Bed Agreement. As ComEd is evaluating potential locations to install Athena's equipment, ComEd is coordinating with Athena to provide additional technical information.

QinetiQ

QinetiQ proposed an Idea for its "bird on a wire" voltage and current sensor technology. The bird on a wire is a grid sensing and monitoring technology that measures voltage up to 36kV and line current. Some of the applications for which it can be used include theft detection, grid automation, voltage and power measurements, fault detection and outage management, asset management, and green energy/renewable integration. QinetiQ's submitted Idea has been reviewed. ComEd has identified a potentially new application for QinetiQ's line sensing

technology. The technology is being evaluated for a potential voltage optimization pilot. It has been determined QinetiQ's Test Bed Idea is a potential Test Bed Demonstration project, pending agreement execution of a Test Bed Agreement. As ComEd is evaluating potential locations to install QinetiQ's equipment, ComEd is coordinating with QinetiQ to finalize next steps for implementation.

EnSync Energy Systems

EnSync Energy Systems, formerly known as ZBB Energy, proposed an Idea demonstrating its matrix product. EnSync intends to verify the matrix product functions in a live-grid environment with full communication. The matrix product regulates bi-directional energy flow to the grid by charging and discharging energy storage devices. For this Demonstration, EnSync proposes to connect the matrix product to a building and a communication network.

Multiple functions of the matrix proposed to be demonstrated will include: active energy synchronization of all DC and AC inputs and outputs, energy storage application management, bulk energy storage, peak shaving, frequency regulation, renewable integration, renewable firming, power factor correction, conservation voltage regulation, smart export between building and utility distribution, microgrid operation, islanding, back-up power, and utility communication and control. In addition, EnSync proposed to demonstrate the Matrix performing several of these active and reactive power functions simultaneously through the use of their patented AutoSync DC bus concept.

This development would incorporate primarily photovoltaics ("PV") generation and energy storage, with the potential to add other energy sources. EnSync will provide all generation assets and controls. ComEd is currently evaluating locations for an effective Demonstration.

As a result of this pilot, EnSync plans to be able to demonstrate supply response on demand and learn to facilitate and create an interface from an electric utility's perspective. ComEd and EnSync would co-author a white paper based on a successful Demonstration of the listed active and reactive power functions and applications. EnSync's Idea is currently under review and coordination for the Test Bed is ongoing.

III. Test Bed Demonstration Projects

Following are summaries of current technology Demonstration projects at ComEd. The list represents projects from a variety of internal and external sources, spanning multiple technology areas. Each project summary includes a symbol designating the current stage of development.

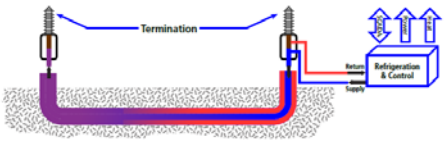
G&W Electric Company

ComEd contractors have recently installed G&W's AccuSense voltage sensing solution. This device enables users to collect critical voltage data for optimizing grid power delivery and reliability. It serves as a smaller, light-weight alternative to traditional voltage transformers and can thus be integrated throughout the grid as metering points. The objective of this project is to evaluate performance of the AccuSense voltage sensor in a field installation. Metering grade, 0.3 class voltage

transformers are being used as a reference when monitoring the AccuSense voltage sensors. The AccuSense voltage sensors and voltage transformers were integrated with an SEL651R control for monitoring purposes. The SEL control serves as the data collection point and will be accessed in intervals to evaluate the performance of the devices. ComEd and G&W will retrieve data from the devices for approximately one year.

Superconductor Development

ComEd and American Superconductor ("AMSC") recently agreed to participate with the Department of Homeland Security ("DHS") in its Resilient Electric Grid Program Developing plans to deploy high temperature superconductor cable in Chicago's central business district ("CBD"). This DHS program is designed to provide protection against the catastrophic effects resulting from the loss of critical substation facilities by allowing the sharing of capacity of nearby substations that cannot typically be accomplished through conventional means.



The superconductor cable would interconnect five key electrical substations in the city and provide enhanced security and redundancy to critical infrastructure. Given the significant level of external

funding and the size and scale of the project, one of the project goals is to significantly reduce the cost of manufacturing the superconductor cable.

In addition to providing reliable power and increased security, this installation of nearly three miles of superconductor cable would create the most extensive superconductor technology infrastructure in the world. ComEd's transformation of its business relies heavily on technology and innovation. In this era of increasingly intense weather events and other potential catastrophic occurrences, this project will not only support the City of Chicago but can serve as a model to enable widespread implementation of the superconductor technology nationally and globally.

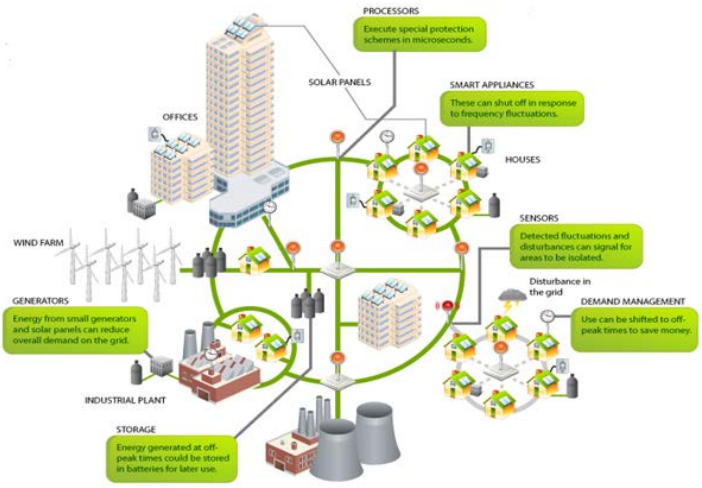
ComEd and AMSC are currently in the midst of a feasibility study to determine operation and deployment viability. The preliminary engineering phase has been extended to align the design with the original approved cost estimate. In lieu of the current 5-station design, Engineering is evaluating an alternative 3-station design. The new target completion of the feasibility study is mid-2016.

Fuel Cell Demonstration

ComEd is working with Toshiba to showcase the first implementation of a 700 Watt Toshiba fuel cell in the United States. The initial Toshiba Ene-Farm unit, originally designed for residential applications in Japan, is being planned for installation at Brookfield Zoo, to provide supplemental power to the Zoo's grid and hot water to a new hand-washing station complimenting the nearby food court. The demonstration will help ComEd and Toshiba to better understand the

operation and applicability of the technology in the U.S., and the exhibit will serve to educate the public on fuel cell technology and energy efficiency. The fuel cell exhibit is being finalized in preparation for a grand opening at the Zoo in Q2 2016.

Microgrid Development



In support of President Obama's Climate Action Plan and the Administration's commitment to improve national power grid resiliency, the U.S. Department of Energy ("DOE") awarded more than $8 million for microgrid controller related R&D projects to help cities and towns better prepare for extreme weather events and other potential electricity disruptions.

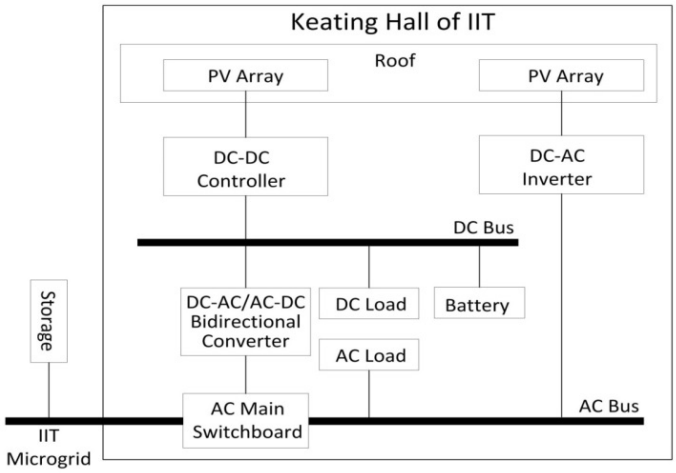
In September 2014, ComEd was selected by the DOE to develop and test a commercial grade master controller that could drive the operations of clusters of two or more microgrids. ComEd's project was the only utility-led effort to receive DOE funding. ComEd has assembled a group of leading science and technology partners, including Argonne National Laboratory, Illinois Institute of Technology ("IIT"), OSIsoft, Quanta Technologies, S&C Electric, and University of Denver. With its partners, ComEd kicked-off the controller development effort in November 2014. The project is scheduled to be completed in Q3 2016.

As part of the controller R&D effort, ComEd is in the midst of evaluating Chicago's Bronzeville neighborhood, adjacent to IIT's existing microgrid, potentially for its first microgrid installation. The microgrid would also demonstrate all the capabilities of the clustered microgrid controller and is currently under development by ComEd. ComEd's proposed microgrid at Bronzeville includes a diverse mix of facilities and critical loads, including police headquarters, major transportation infrastructure, healthcare facilities, educational facilities, and private residences. To date, ComEd has completed six sub-task reports for the DOE as part of the grant deliverables. The reports have concentrated on evaluating the Bronzeville neighborhood in terms of loading and potential for generation installation for purposes of a microgrid. Additionally, ComEd has submitted preliminary test plans to the DOE and has conducted a briefing for the DOE Technical Advisory Group ("TAG"), which has responsibility for reviewing the technical aspects of the project. ComEd is working with the DOE TAG to finalize the controller test plans.

In January 2016, the DOE announced that ComEd received a grant under the sustainable and holistic integration of energy storage and solar PV (SHINES) funding. This grant allows ComEd the opportunity to research, develop, and test microgrid integrated solar and storage technology (MISST) within the footprint of the proposed Bronzeville Community Microgrid. The grant will be a total of $4M from the DOE to develop and demonstrate the MISST technology.

Nanogrids: AC/DC Hybrid Systems

ComEd, IIT, Argonne National Lab, DOE, Emerge Alliance, and Starline DC Solutions are partnering to develop a hybrid nanogrid for IIT's Keating Hall. This effort is funded through a U.S. DOE grant. Nanogrids are a sub-category of microgrids, generally supplying power to a single building or load. Hybrid nanogrids include both alternating current (AC) and direct current (DC) circuitry. As the name suggests, nanogrids are generally much smaller than conventional microgrids. DC loads, such as data centers, electric vehicle charging stations, and LED lighting, together with the proliferation of DC-based distributed generation and energy storage are likely to reshape power distribution.



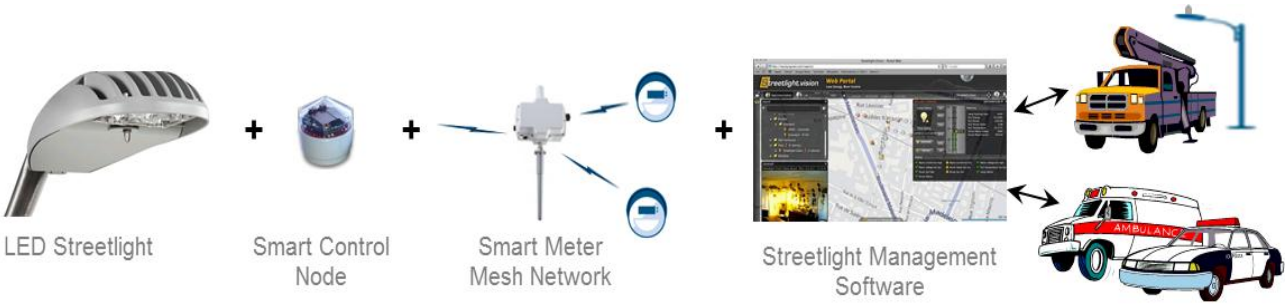
The Keating Hall nanogrid will incorporate PV generation, energy storage, LED lighting, and power electronic based conversion equipment. The main drivers for hybrid nanogrid development are: 1) DC based PV assets installed on the rooftop; 2) reduced conversion losses, through centralized energy conversion; and 3) LED lighting solutions for more efficient and controllable lighting for the building.

The overall goal of the project is to learn about integrating the AC and DC systems for a building-scale nanogrid solution. The learnings from this small demonstration could enable ComEd to apply these technologies in future microgrid and nanogrid deployments. The project does not only include installation of new technology, but

applying that technology to robust integration of renewables and improved energy efficiency. The project commenced after a 5-month delay, which was due to the Department of Energy's funding delay. The Controller Algorithms that are being developed under the microgrid controller grant will be applied to this project. Project is on schedule and expected to be completed by August 2016.

Smart LED Streetlights

ComEd is evaluating opportunities to offer smart LED streetlight service to communities within its service territory. The solution would leverage the wireless mesh communications network that is currently being built as part of ComEd's smart meter deployment. The ubiquitous nature of the network allows ComEd to reach all areas within its territory, extracting additional value from the smart grid investments ComEd is already making.



This service would include a smart streetlight control node installed on each light fixture. The control node includes the same wireless radio found in ComEd's smart meters, allowing it to communicate on the same mesh radio network of the smart meters.

This smart LED streetlight solution offers a variety of benefits. First, the highly-efficient, longer-lasting LED fixtures with remote control & monitoring significantly

increase energy savings and reduce maintenance costs when compared to incumbent technology. They also improve security and safety through fewer light failures and greater resiliency to damage. Since each control node includes revenue grade metrology, improved accounting for energy usage would be possible, as would the potential further energy reductions through functions such as streetlight dimming.

To monitor and control the smart streetlights, web-based streetlight management software would be made available to various user groups, with specific functionality sets catered to their roles (e.g., emergency responders, maintenance personnel, event management). Once connected, these streetlights could be remotely controlled via pre-set schedules and/or on an ad-hoc basis, either individually or in groups. Also, the web portals for police and emergency responders enable lights to be controlled on demand in the event of an emergency.

In Q4 2014, ComEd initiated a proof of concept (POC) pilot of smart LED streetlights in two communities it serves – Bensenville and Lombard. During Q1 2015, approximately 750 smart LED fixtures were installed, collectively, between the two municipalities. Each fixture was equipped with a newly developed CIMCON brand control node. The POC pilot also included the provisioning of streetlight management software to the two municipalities, equipping them with direct control over and monitoring capability of the streetlights. By late April 2015, all pilot hardware and software had been deployed and authorized personnel from the pilot municipalities were subsequently trained on

use of the systems. Since this time, ComEd staff members have been monitoring these streetlights, performing detailed functionality testing, identifying technical issues, and, in turn, making improvements to the systems. ComEd has also been monitoring the impact of these lights on the AMI communications network to rigorously determine how streetlights affect core AMI operations.

Through POC deployment, monitoring of operations, identifying and triaging of issues, and developing system enhancements with vendors, ComEd developed a thorough understanding of the technical capabilities of this technology. ComEd also evaluated customer preferences with respect to this potential new service offering. The results of the POC pilot will be used to make informed decisions on deploying the technology on a broader scale.

Smart FAA Warning Lights

Three new poles equipped with new LED FAA warning lights were installed in downtown Dixon, due to the close proximity of a nearby hospital heliport. The new lights are equipped with a communication panel that leverages the capability of ComEd's wireless mesh communications network to provide real-time status of the lights. When a failure is indicated, the communications panel communicates this to ComEd's SCADA system and sends texts and emails to the appropriate personnel so issues can be addressed promptly. Additionally, loss of power to the system, or a communications failure will trigger an alarm. ComEd is currently exploring opportunities to streamline the design of the

smart FAA warning lights by integrating the same control node being used in its smart streetlight pilot to reduce equipment and installation costs.

Pedestal Communications Relay

ComEd engineers recently developed an innovative solution to a significant operational challenge. When designing and building the distribution automation ("DA") or advanced metering infrastructure ("AMI") radio communications networks, it is not unusual to encounter conditions where traditional standards and methods are not feasible.

DA radio communications relay equipment is traditionally installed only on overhead facilities. These relay radios may take the form of pole-top antennas, lighting brackets or even decorative streetlights. However, each installation requires an overhead structure for mounting both the radio and antenna hardware.

In the past, ComEd has identified multiple situations where existing overhead standards cannot be used. These conditions are most often caused by:

- No existing overhead infrastructure in the general area (underground subdivision)
- Distribution poles are not owned by ComEd
- Installation of a new pole is not feasible
- Utility easement is only provisioned for underground facilities

The above conditions present significant challenges to designing efficient, cost-effective radio installations. In some cases, there was no existing feasible solution.

Two ComEd engineers developed an innovative solution to solve the problem by creating a ground-based radio repeater using a conventional three-phase pedestal. This chassis, commonly used within the utility, is very rigid and can be installed within underground easements and public right-of-ways ("ROWs").

The pedestal is used to house all of the conventional overhead radio equipment. This equipment is mounted and installed inside the box using all of the standard mounting hardware used to attach a relay and bracket to a wood pole. The benefits include:

- Enclosure, radio, and hardware are all existing items within ComEd stores
- Time to assemble and install is less than pole-based solutions
- Cost is less than setting new poles or adding relays
- Any maintenance can be performed from ground level
- Secondary enclosure is less intrusive than a 40-ft pole
- Equipment installation resembles a standard three-phase pedestal
- Unit does not require a concrete pad and can be relocated, as needed
- Safe to install, operate and maintain
- Has been deployed twice as a solution for AMI communications that could not have been resolved with traditional overhead construction

- Can be used as both a relay and as an Access Point
- Has potential to resolve communications issues in other smart grid applications

The pedestal communications relay has proven to be effective and cost-beneficial. ComEd has applied for a U.S. patent for this innovative new technological solution. The new relay has been formally approved by ComEd Distribution Standards and introduced as a new construction standard. A solar version of the relay is also currently under development.

Smart Meter Connected Devices

ComEd is identifying compatible retail in-home wireless devices to facilitate customer access to billing information and near-real-time, electricity usage information provided directly from the meter. ComEd's Smart Meter Connected Devices ("SMCD") service, launched in October 2014 on ComEd.com, enables residential customers to receive electricity usage and cost information, and, in some instances, messages and alerts, through a wirelessly connected smart device that communicates with the ComEd smart meter installed at their home. With access to more information about their electricity use, customers can make changes that can help them manage their electric bills.

A SMCD participant can purchase any retail smart devices that meet program requirements, register the devices with ComEd, and ComEd will wirelessly connect the devices to the ComEd smart meter at their residence. Qualified program devices include:

- **In-Home Displays ("IHDs")**: IHDs have the ability to display electricity usage and cost information available from smart meters. IHD features may also provide access to time of day, price and cost of electricity, as well as text messages. This information appears on the digital display of the device shortly after electricity is used. Some IHDs display energy costs (Price * Usage) based on the fixed-price electricity supply rate from ComEd or other electric service suppliers as well as ComEd delivery rates.
- **Energy Management Devices**: These devices can take multiple forms but are most commonly Programmable Controllable Thermostats. Some Energy Management Devices have features similar to IHDs plus additional capabilities that allow consumers to actively manage electricity usage by providing notification of unusual periods of high electricity use.
- **Other Devices**: Smart appliances, range extenders (which boost or extend Wi-Fi signals) and internet gateways are examples of other smart devices that may be capable of receiving information from smart meters.

As of February 2016, Smart Meter Connected Devices has 173 customers who have requested smart devices and have been connected. ComEd has been collaborating with Illinois Science and Energy Innovation Foundation (ISEIF) to test the SMCDs and

to leverage the devices for various customer behavior studies and related research. ComEd currently is working with three device manufacturers (Rainforest Automation, Aztec, and Ambient), and the service is contacting and testing several new vendors to add more devices to the prospective vendors list. ComEd is also exploring further expanding the SMCD service in the future, as well as automating the process to add more customers.

Bidgely HomeBeat™ Pilot

ComEd is conducting a pilot with Bidgely, a leading energy analytics Software as a Service ("SaaS") provider serving utility customers, to test Bidgely's new HomeBeat™ Energy Monitor and Web & Mobile engagement solution with ComEd customers. ComEd is one of the first utilities to offer to customers this technology, which will provide them with personalized energy reports detailing how and when they use energy in their homes. The pilot targeted the participation of 30 employees. However, 6 employees were unable to complete the program due to connectivity issues or personal reasons.

In Q3 2015, ComEd completed the pilot's first phase: 24 ComEd employee participants received the HomeBeat Energy Monitor, which connected directly to their ComEd smart meter and provided real-time energy usage data to the Bidgely cloud. Via a process known as disaggregation, the information is analyzed in near-real-time to provide appliance-level energy use to the participant through the Bidgely Web and Mobile platform. After the employee home-user acceptance test, an additional 2,500 participants will receive access to Bidgely's HomeBeat Web & Mobile platform. As ComEd's review of potential systems continues, the schedule and deployment

strategy of Phase 2 of the pilot are subject to change. Phase 2 of the pilot will launching in the late Q1 to Q2 2016 timeframe and will run for approximately six months. During Phase 2 of the pilot, ComEd is working with Silver Springs Networks to explore their Silver Link Sensor Network technology, which is currently in development and testing. This platform will provide a real-time data feed directly from the AMI network to third-parties, such as Bidgely, to act as an energy disaggregation solution for customers.

Bidgely's HomeBeat platform will provide personalized appliance-level insights through the company's disaggregation-based solution. This technology will empower customers to take specific actions that will help them save energy. The inclusion of Bidgely's HomeBeat Energy Monitor enables ComEd to offer real-time energy insights, such as high-usage alerts via mobile push notifications within minutes of use.

ComEd is one of the first utilities to offer Bidgely's new suite of HomeBeat products, which include:

- **HomeBeat Web & Mobile app**: Enhanced mobile app that provides real-time notifications and insights around energy use and puts the ability to make smarter decisions about energy in the palm of the customer's hand.

- **HomeBeat Energy Monitor**: Simple and affordable in-home gateway that syncs smart meter data with Bidgely's cloud to enable real-time energy insights.

MeterGenius Pilot

MeterGenius is a local Illinois start-up launched by Northwestern University students in 2013. The MeterGenius platform allows residential consumers to view their electricity consumption data via web and mobile applications, set an energy budget, receive tips on reducing usage, and earn rewards. ComEd has been working with MeterGenius to develop a 6-month pilot for select ComEd customers with smart meters to determine the amount of electricity MeterGenius' platform can save, along with impacts on customer satisfaction and engagement in other ComEd efficiency programs.

The MeterGenius pilot, launched in December 2015, will run for 6 months and continue through May 2016 with the option to extend through summer. The pilot includes nearly 6,500 randomly selected ComEd customers that have smart meters installed at their homes. MeterGenius leverages the smart meter network to show participants 30-minute intervals of their usage data, which is updated the next day. The customers have unlimited access to MeterGenius' web and mobile applications, which allows them to budget and track their energy usage on a granular level by the hour, day, week or month. Participants also receive monthly communications with customizable tips on how to lower their electricity bills, and with energy-efficient habit reminders such as closing the blinds during the day to reduce cooling costs and defrosting the freezer on a regular basis in order to increase its efficiency. By using MeterGenius' tools, participating customers can earn points that can be redeemed for gift cards and energy efficient products. Additionally, they can register for weekly

contests to compete against neighbors to see who most lowered their electricity consumption compared to the previous week.

Thermostat Pilot

During the summer of 2015, ComEd launched a WiFi-enabled thermostat pilot as part of ComEd's Central Air Conditioning ("AC") Cycling Program (i.e., Rider AC). ComEd customers in the pilot could earn up to $40 during the summer (i.e., June 1, 2015 through September 30, 2015) by allowing ComEd to adjust the temperature of the customer-owned WiFi-enabled thermostat. Customers in the 2015 pilot could participate using either a Nest or a Comcast\Xfinity WiFi-enabled thermostat. There were 2,988 Nest Thermostat customers and 316 Comcast\Xfinity Thermostat customers that participated in the 2015 pilot. In 2014, ComEd offered a similar pilot but only Nest Thermostats could participate during that summer. Below is additional information on the two thermostat companies that provided demand response services to ComEd using WiFi-enabled thermostats:

1) Nest Thermostat – provided the Nest Learning Thermostat™ in the 2014 pilot, scheduling demand response events under their "Rush Hour Rewards Program".

2) Comcast Thermostat – offers a demand response platform under the XFINITY Home Services brand. Comcast uses the Wi-Fi-enabled EcoFactor Thermostat to curtail customers.

The Nest and Comcast Pilots allow ComEd to test the smart thermostat products as devices for residential demand response, enhance customer experience and engagement, and introduces a channel for customers to obtain innovative technologies that help them use less electricity when it is most in demand.

As part of ComEd's AMI rollout, customers with smart meters were able to participate in ComEd's Peak Time Savings ("PTS") Program during the 2015 summer months. Some of the customers who sign up for the PTS Program were able to participate in a Direct Load Control ("DLC") Pilot that will leverage a Programmable Communicating Thermostat ("PCT") device similar to the Nest device used in 2014. The experience of the Thermostat Pilots in 2014 and 2015 will directly benefit ComEd's efforts to operate their DLC Pilot in 2015 and shape future residential demand response programs.

Green Button Connect My Data

In May 2015, ComEd partnered with Schneider Electric to deploy Green Button Connect My Data in northern Illinois. Green Button is an industry initiative stemming from a White House call to action for utilities to voluntarily provide customers with easy access to their energy usage in a secure and user-friendly electronic format. ComEd is among the first utilities to introduce Green Button Connect My Data, which allows customers to authorize third-party service providers to receive direct access to their energy usage analytics via the Green Button functionality. To help customers maximize energy savings via the Green Button Connect My Data functionality, ComEd offered Energy Insights Online, a free web-based energy analysis service that interfaces with Green Button. Energy Insights

Online provided ComEd's commercial customers a more detailed analysis of their building's energy usage. It, also, enabled third-party vendors, such as Schneider Electric, to provide automated monitoring based commissioning (aMBCx) technology with embedded fault detection and diagnostics (FDD) analytics that accurately prioritize energy savings opportunities.

The ability to transfer this data more seamlessly to third-party developers will help accelerate technology applications and analytics leveraging smart meter data. ComEd integrated the Green Button Connect functionality for its Commercial & Industrial customers in Spring 2015. Elmhurst Hospital is among the first of ComEd's commercial customers to take advantage of ComEd's Energy Insights Online and Green Button Connect My Data. Using the Schneider Electric utility interface, data is pulled from different sources, including three onsite ComEd smart meters, with information Schneider Electric compiles in 5-minute intervals via 13,000 sensor points within the HVAC control system. Working with ComEd and Schneider Electric, Elmhurst Hospital was able to leverage these tools and their smart meters with zero additional investments in hardware or software to reduce the energy costs of their 866,000 square feet facility. ComEd successfully deployed Green Button Connect for residential customers in two phases. The first phase allowed third-party vendor registrations and was completed in October 2015. The second phase enabled the customer facing portion of Green Button Connect and was completed in December 2015. The customer facing portion will be made available to the public in 2016. ComEd currently has one third-party vendor registered and is working to expand this list throughout 2016.

Root3

ComEd has contracted with Root3 for a one-year pilot of its Balance energy management system ("EMS") at four industrial/large commercial locations. The Balance tool uses big data and predictive analytics to optimize energy operations and enable strategic energy planning at chilled water, steam, cogeneration, and compressed air plants (also referred to as Central Plants).

Balance has a step-by-step guidance system that updates based on ambient conditions and helps operators eliminate waste and improve their productivity and dispatch consistency across shifts. Algorithms in Balance continuously track operational efficiency and effectiveness. This makes it easier to identify bottlenecks and continuously improve energy operations. Balance also brings together data from a site's existing energy management system and plant process control systems, and combines it with information on weather, energy prices, operational constraints, business constraints and goals. It uses algorithms to continuously predict the safest,

most reliable, and most cost-effective way to run a plant. In this aspect, Balance is very much like a navigational system, guiding users to Lean Energy Operations.

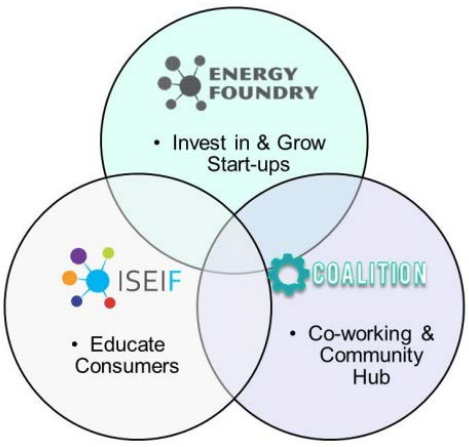
Another advantage of Balance is that it requires no capital investment to deploy – it uses data from a plant's existing sensors and meters.

To date, ComEd has one of four locations secured for the pilot, and has Balance installed, operating, and collecting data at the site in August 2015. Operators began receiving recommendations from Balance starting in November 2015. The other three open locations are being pursued by ComEd and Root3. Preliminary data collection on the second site has begun.

IV. Smart Grid Collaboration

ComEd recognizes that great innovations come from engaging forward-thinking individuals with a broad diversity of perspectives, experiences, and expertise. That's why ComEd is forging key relationships with industry leaders, technology accelerators, universities and others, to further encourage the development of new and innovative grid-related products and services by entrepreneurs. Following are a few examples of key collaborative relationships and events that ComEd has established to seek out – and celebrate – innovation.

Energy Foundry



In addition to providing an initial funding investment, ComEd continues to support the Energy Foundry in its mission to foster innovative new grid-related and energy-related products and services. ComEd's executives periodically hold office hours at the Foundry's Coalition Space in downtown Chicago to talk face-to-face with entrepreneurs and provide the utility perspective as new ideas are developed. The pipeline continues to be robust, with applications received that span across a diverse range of business sectors and development stages such as gas, water, energy storage, transportation, generation, power electronics, building technology and infrastructure. Leadership at the Energy Foundry has developed the selection criteria to help entrepreneurs achieve their highest goals and an investment model to accelerate speed to market for promising energy ideas. To date, the Energy Foundry has made investments in the following companies:

Prior Investment Activities

- **Advanced Diamond Technologies:** An Argonne National Lab spin-out that developed an innovative method to manufacture a synthetic diamond coating for with end use applications in power electronics, industrial components, and power generation.

- **Bractlet:** A software sensor and analytic platform that allows large energy service companies to efficiently and continuously measure the savings of energy efficiency retrofits.
- **Digital H2O:** They are a software and analytics platform that enables cost-effective and sustainable use of water in energy processes. Their innovative, data-driven platform simplifies and advances water management in fragmented supply chains, and promotes the sustainable use of water resources in energy production.
- **EDCS Power:** They are a DC-based Uninterruptible Power System (UPS) technology that provides the missing link to convert data centers to DC power, and creates a path to commercializing DC microgrids and direct integration of renewables.
- **GlidePath**: Developing next-generation power resources, including grid-scale energy storage, using cutting-edge technologies and strategies.
- **Intellihot**: A tankless water heater that targets the commercial market (i.e., hotels, restaurants, etc.). Achieves savings in energy and installation costs, while enhancing reliability. They have a development path that includes combined heat and power.
- **Root3:** An integrated software decision tool that helps Central Utility Plants with $1M - $10M in energy spend optimize their decision-making, enabling them to meet energy demands with the lowest fuel and capital spend. They have a development path that includes smart controls and integrated demand response.

- **SiNode**: An early stage advanced materials company developing the next generation of lithium-ion batteries, with a core focus on silicon-graphene anode technology.

CSMART Laboratory at IIT

Built with the support of IIT, ComEd, Silver Spring Networks and West Monroe Partners, CSMART is one of the first of its kind to bring together academic, industry and utility experts to provide a fully-functional test environment for smart grid and smart city technology.

CSMART provides the platform to conduct a wide range of smart grid and smart city R&D analysis projects. Some of the initial state-of-the-art demos include:

- **Smart street lights operational testing:** Intelligent and adaptive networked street lights can reduce operating and maintenance and energy costs by 75 percent through LED lights that are controlled and connected by a network. The software helps provide scheduling, remote on/off and dimming features as well as outage detection notification for faster repairs to ensure the safety of citizens and the community. Smart street lighting networks can also establish a platform upon which additional smart city applications can be deployed.
- **Street Light Smart Applications**: Exploring and developing an application integrating the campus 911 emergency call buttons with the smart streetlights that

enables control of streetlights based on activation of 911 call button. The key research component is how to intelligently and precisely correlate the streetlights with an external information source. Current efforts are building on the successful pilot to implement motion sensing and "on the edge" group control.

- **Cyber-security Evaluation of the IIT Smart Streetlight Project**: Conducting a complete cyber-security evaluation of the prototype system currently installed in the CSMART lab to discover potential vulnerabilities in the smart streetlight system, and investigating means to eliminate or mitigate them.
- **Distributed Energy Resource Management – ConnectTheGrid™**: Cloud-based application that provides work-flow management and an online dashboard for utilities to manage distributed generation application approvals, including roof top solar, as well as providing asset tracking, reporting and forecasting.
- **Data analytics and real time interactive dashboard**: Smart-grid communications networks are used to monitor operations and collect data from throughout IIT's electric microgrid in order to optimize electrical efficiency of the system and predict faults prior to their occurrence.
    - **PMU Data Collection and Analytics:** Eight phasor measurement units (PMUs) are in place at IIT. All eight of these communicate with a phasor data concentrator (PDC) controller responsible for data collection. Current efforts are focused on integrating PMU data with the OSIsoft Asset Framework Template.
- **(GRIDCO) "Advanced Distribution Automation: In-Line Power Regulator (IPR)"**: Initially testing and demonstrating two use cases that are relevant to the

utility business: Conservation Voltage Reduction ("CVR") and detection of technical and non-technical losses. If tests are successful, this will demonstrate not only the Gridco Systems product but also the concept of distributed local control for the distribution grid using Smart Meters and Bridges on the Silver Spring communications network. Other applications include distributed power factor control and distributed harmonic mitigation, which will be tested in later phases of the project.

- **IIT Single Line-diagram – mapping the IIT Micro-grid**: Utilizing OSIsoft's PI ProcessBook to create a live updating one line diagram that condenses the microgrid data into one easily accessible location for IIT facilities members and for faculty and student research. Stores historical microgrid data at 5-second intervals in condensed and easily searchable form for analysis and adds real-time notifications to microgrid assets to inform facilities and faculty of changing statuses around the campus.

- **OSIsoft Asset Framework ("AF") Template Project:** Creating a Common interface model ("CIM") for the campus microgrid including solar, battery storage, Cogeneration, wind, as well as relay and protection. This model will serve as an input to a CIM translator into OSIsoft's Hierarchical data management software. The CIM translator has the added benefit of automatically creating PI tags (data points in the PI system) which removes many man-hours of configuration.

- **UFARM Campus community garden:** Initiated by the IIT chapter of *Engineers for a Sustainable World* this facility is a test-bed for the development of urban

agricultural technology. Current projects are heavily focused on networked monitoring and intelligent irrigation controls.

- **Microgrid SCADA:** Utilizing Alstom SCADA software and existing Silver Spring Networked devices this tool will be used in parallel with production controls and monitoring to establish control of edge devices (Smart Streetlights initially) and a development environment for microgrid specific SCADA.
- **IIT DC Nanogrid:** Complementing the 200 kW Photovoltaic installation on Keating Hall this project adds a DC bus, micro controller, and 8 hours of battery storage to power building loads (DC) without the losses of an inverter. The first major application is the upgrade of gymnasium lighting to controllable LEDs.

SmartGridExchange™

The mission of the SmartGridExchange™ (SGE) is to discover, seek out, foster, and execute pilots and innovative products and relationships. This collaborative initiative between ComEd, entrepreneurs, technology start-ups, universities and customers seeks to explore and shape new products, offers and innovative solutions that utilize the intelligence and benefits of the smart grid. Through the SmartGridExchange™, ComEd is starting the process of co-designing the future of electricity with companies interested in developing smart grid-enabled products and services. These include enabling third parties to develop new products

and services that leverage the smart grid investments ComEd is already making; working with select developers who bring demonstrated value to customers; and giving customers a convenient portal from which they can learn about new and developing energy products and services.

In addition to the Bidgely Pilot, Thermostats Pilot, MeterGenius Pilot, Green Button Connect My Data, and other programs detailed in the previous section, some additional initiatives and demonstrations already underway through the SmartGridExchange™ include the following:

- Through ongoing market scans and ideation sessions, the SmartGridExchange™ has already become the birthplace of multiple new technology demonstrations, and collaborations, including Smart Meter Connected Devices, Bidgely, Nest Learning Thermostat™, and Root3 described in the Current Demonstration Projects section above.
- ComEd, in partnership with Accenture, hosted its second annual SmartGridExchange™ Forum in downtown Chicago in November 2015, bringing together leading technology and innovation companies with other customer and stakeholder organizations, including the City of Chicago, Citizens Utility Board and Smart Grid Consumer Collaborative, to discuss how to leverage the smart grid to deliver increased value to consumers.

The SmartGridExchange™ initiative has continued to introduce, vet, and advance new ideas and potential pilots while continuing to deploy existing in-market initiatives and programs. The SGE Team has continued biweekly market assessments of industry developments and to identify products and solutions with potential for piloting or

collaboration under SGE. New technologies that have been vetted are continuously added to the SGE initiative pipeline to monitor, evaluate, and charter new initiatives and pilots. The SGE team has been meeting with vendors and program managers to explore, discuss, and structure potential pilot program design.

Clean Energy Inspiration Awards

ComEd is partnering with the Clean Energy Trust ("CET") and City Colleges of Chicago ("CCC") to launch a local version of the national Clean Energy Challenge that showcases the best ideas for entrepreneurial businesses sourced from City College students and recent alumni. The partnership engages local community network to reach new millennials from diverse backgrounds that can contribute and take advantage of the clean energy economic revolution. The program runs from an August 2015 launch for applications, to an October 2015 mentorship period for selected applicants, and finally to a live judging and awards ceremony in November 2015. The intent is to pilot this program in Chicago and work to scale it up regionally and eventually nationally. The goal of the program is to engage diverse urban communities in the discourse about the economic power of clean energy and sustainability and to help identify job opportunities for this targeted population.

EPRI Smart Thermostats Collaboration

Advances in technology have led to the development of a new generation of programmable communicating thermostats that hold the potential for energy and demand

savings at a relatively low cost to electric and gas utility customers.

Known as “smart thermostats”, these control devices for space conditioning systems have capabilities beyond just allowing the customer to program temperatures for different times of the day and days of the week. They allow customers to remotely program their thermostat, often via internet-enabled devices (such as a PC or mobile device) with a consumer-friendly user interface. They enable two-way communication of data outside the building premises (either built-in or expandable), including indoor temperature data, operational sequence of space conditioning equipment and so on. They can also be adapted to receive demand response event signals from utilities.

Industry experience has shown that customer acceptance and usability can be key drivers to a thermostat’s energy or demand reduction potential. Given that smart thermostats may offer better customer usability due to their remote programming capability, the objective of this project is to evaluate their energy and demand savings impacts, as well as how customers perceive and use them.

In 2014, Exelon Utilities joined the Electric Power Research Institute’s (“EPRI”) Evaluating Smart Thermostats' Impact on Energy Efficiency and Demand Response project which is being executed under EPRI’s program 182, Understanding Electric Utility Customer. During the summer of 2015, ComEd had two thermostat pilots underway and joining the EPRI effort will provide the opportunity to not only share the learnings from ComEd’s own pilots, but to learn from the pilots that are being conducted by nine other utilities participating in this project. EPRI’s research activities cover pilot design as well as technology scouting and review. Additionally, EPRI will serve as a third party for evaluation, measurement and verification (EM&V) of each

member pilot's ability to achieve established objectives. New learnings for the industry and the public will come about through collaboration and conducting pilot projects to evaluate the capabilities of various vendors and technology. During Q2 and Q3 2015, the EPRI Smart Thermostats Collaborative conducted several workshops and webcasts on topics related to the project.