NETL PARTNERS WITH THE CITY OF PITTSBURGH AND REGIONAL STAKEHOLDERS TO HELP DESIGN AND IMPLEMENT A 21ST CENTURY ENERGY INFRASTRUCTURE

ESTABLISHING PITTSBURGH AS A NATIONAL MODEL AND GLOBAL LEADER

Memorandum of Understanding with the City of Pittsburgh

October 12, 2016

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INTRODUCTION

The National Energy Technology Laboratory (NETL) is a U.S. Department of Energy (DOE) national laboratory that produces technological solutions to America's energy challenges. For more than 100 years, the laboratory has developed tools and processes to provide clean, reliable, and affordable energy to the American people.

NETL's current mission is to discover, integrate, and mature technology solutions to enhance the nation's energy foundation and protect the environment for future generations. Through forward-looking research and technology development, the Laboratory's team of talented and diverse experts provide technology solutions for today and options for tomorrow.

Ever since 18th-century entrepreneurs chiseled exposed chunks of coal from the cliffs of Mount Washington in Pittsburgh, PA, the business of providing safe, efficient, and affordable energy to power the City of Pittsburgh's upward economic trajectory has been an engine for progress.

Since 1910, NETL has been a sparkplug of innovation supporting the city in its industrial and economic evolution with new ideas for safety, efficiency, and productivity. Now, as Pittsburgh celebrates its bicentennial and prepares for a third century as a great American city, NETL is playing a key role in helping develop new ideas and approaches to keeping the city on the national and international forefront of energy innovation by providing input on a range of aggressive new projects.

This paper provides an update on progress being made under a Memorandum of Understanding between the National Energy Technology Laboratory and the City of Pittsburgh towards the development of a modern energy generation and delivery system.

BACKGROUND

The City of Pittsburgh and the National Energy Technology Laboratory (NETL) are expanding upon a century-long history of collaboration to focus on a range of energy-related endeavors with goals that will benefit future generations. NETL is helping Pittsburgh elevate its technology-based economic development successes by supporting energy efficient innovations establishing the city as a global leader in clean energy and transportation planning, modeling, and implementation.

Once known as "the smoky city," Pittsburgh's renaissance created a new technology-based backbone of industries that have reshaped the city's image, physical appearance, and outlook for the future. The newest phase of its evolution is centered upon improving its carbon emissions, energy efficiency, power generation and distribution, and transportation. NETL, a Department of Energy National Laboratory specializing in clean energy research, is lending the city its expertise and advice for moving toward its efficiency goals.

Since 1910, the federal energy research organization now known as NETL has been a sparkplug of innovation supporting the city in its energy, industrial and economic evolution with new ideas for safety, efficiency, and productivity. Now, as Pittsburgh celebrates its bicentennial and prepares for a third century as a great American city, NETL is playing key role in Pittsburgh's vision to create a 21st century energy generation and distribution infrastructure that will build upon the city's existing

electrical grid and district energy systems, resulting in a "grid of microgrids"—a network that adapts and connects distributed energy resources with customers.

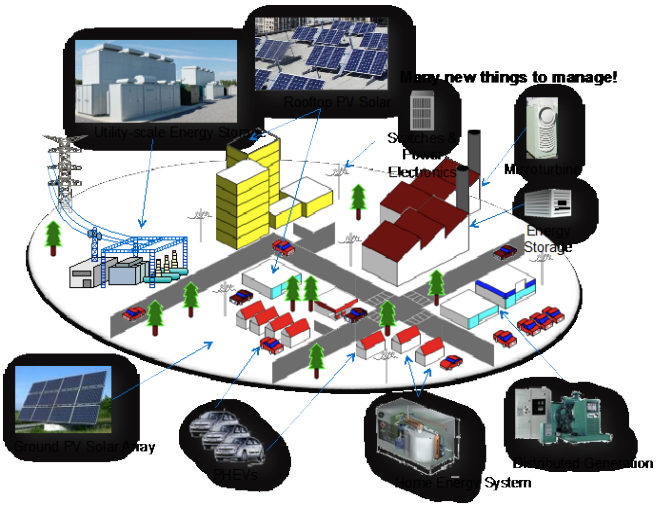

FIGURE 1. MICROGRID
SOURCE: GREEN ENERGY CORP.

Distributed energy resources (DERs) are smaller-scale, modular, electric and thermal energy-generation and storage devices like combined heat and power, gas turbines, microturbines, wind turbines, PV solar, batteries, fuel cells and geothermal. Coupling these energy resources with local consumers or loads creates a localized grid called a microgrid (Figure 1) that is connected to but can run independently from the larger, centralized power grid to help improve power reliability and quality, increase system efficiency, enhance environmental performance, and provide grid-independence to individual end users. Multiple microgrids can be tied together to create a "grid of microgrids" that can further increase system reliability and resiliency. If successful in Pittsburgh, the grid of microgrids concept could serve as a model for other cities adapting to the challenges of a changing energy paradigm.

MEMORANDUM OF UNDERSTANDING

NETL signed a Memorandum of Understanding (MOU) with the City of Pittsburgh on July 17, 2015 to assist the city in implementing the grid of microgrids concept. Teaming with NETL and the City are the DOE's Jobs Strategy Council, University of Pittsburgh Center for Energy, and the region's philanthropic foundations. Under the memorandum, the Laboratory is helping Pittsburgh with:

- Creating social responsible networks of distributed energy generation and storage systems to increase resiliency, reduce carbon footprint, and improve efficiency
- Providing a platform to accelerate adoption of advanced distributed energy resources such as microturbines, direct current power deliver, CHP, reciprocating engines, energy storage devices, photovoltaics, and wind turbines
- Promoting advanced, smart and socially responsible transportation infrastructure powered by locally generated energy
- Meeting the goals and objectives of the City of Pittsburgh Climate Action Plan 3.0

FIGURE 2. NETL DIRECTOR DR. GRACE BOCHENEK AND PITTSBURGH MAYOR WILLIAM PEDUTO SIGN MOU ON JULY 17, 2015

Pittsburgh is uniquely positioned to blaze a development trail for the concept because it has a number of existing distributed energy resources that already provide power to a range of specific organizations

and institutions in separate locations around the city. The challenge ahead is to organize those existing distributed energy systems and help them interconnect through new "energy districts" within the city.

Existing and Proposed Distributed Energy Systems

The five existing distributed energy systems that the city and NETL see as energy districts that could serve as a spine for future grid of microgrid development are:

- Pittsburgh Allegheny County Thermal (PACT), established in 1983 to serve 59 buildings downtown including many local government buildings

- Duquesne University's Cogeneration Plant, which began operations in 1997 and produces 85 percent of the electricity used on a 50-acre campus

- NRG Pittsburgh site, which began operations in 1999 and provides power to more than 30 buildings on the North Side

- Bellefield Boiler Plant, built in 1907 to serve most of Oakland's major institutions, including Carnegie Museums of Pittsburgh

- Carrillo Steam Plant in Oakland, which began operations in 2009 to serve the University of Pittsburgh and University of Pittsburgh Medical Center (UPMC)

In addition, the city is in various stages of developing five new distributed energy /micrgrid projects:

- Duquesne Light Company is installing a nominal 10 MWe microgrid at their Woods Run operations center on Pittsburgh's north side. The facility will be used to investigate challenges and solutions to integrating distributed energy technologies such as photovoltaics, wind, and energy storage. The microgrid is scheduled to be operational in late 2017.

- Linking district energy with the modernization of the City's transportation infrastructure, the 2nd Avenue Energy District project will combine garage and rooftop photovoltaic solar and battery storage with electric vehicle charging stations along the 2nd Avenue corridor from Homestead to downtown Pittsburgh.

- NRG Energy and UPMC Mercy have signed an agreement to build a new steam plant to deliver heat, chilled water, and backup electricity a 28 acre site in the Lower Hill/Uptown District that includes the PPG Paints Arena and UPMC Mercy hospital. The agreement was approved by the City Council in early September 2016.

- UPMC-Oakland socially responsible microgrid concept is based on a design employing ultra-high resiliency and reliability that would continue electrical services to key infrastructure as well as provide the local community with shelter during extended grid outages

- Brunot Island power station that could potentially serve commercial loads

- Larimer Energy District, a community-based microgrid that would be part of the redevelopment of a 285-acre neighborhood in Pittsburgh's East End

- ALMONO Energy District, a mixed-use development in Hazelwood on a 178-acre former steel mill riverfront that would be operated almost exclusively on renewable-based distributed energy

Figure 1 below depicts the location of the City of Pittsburgh's existing distributed energy sites and proposed microgrids and energy districts. The Duquesne University cogeneration plant and the Carrillo and Bellefield steam plants could potentially become part of the Uptown and Oakland microgrids, respectively.

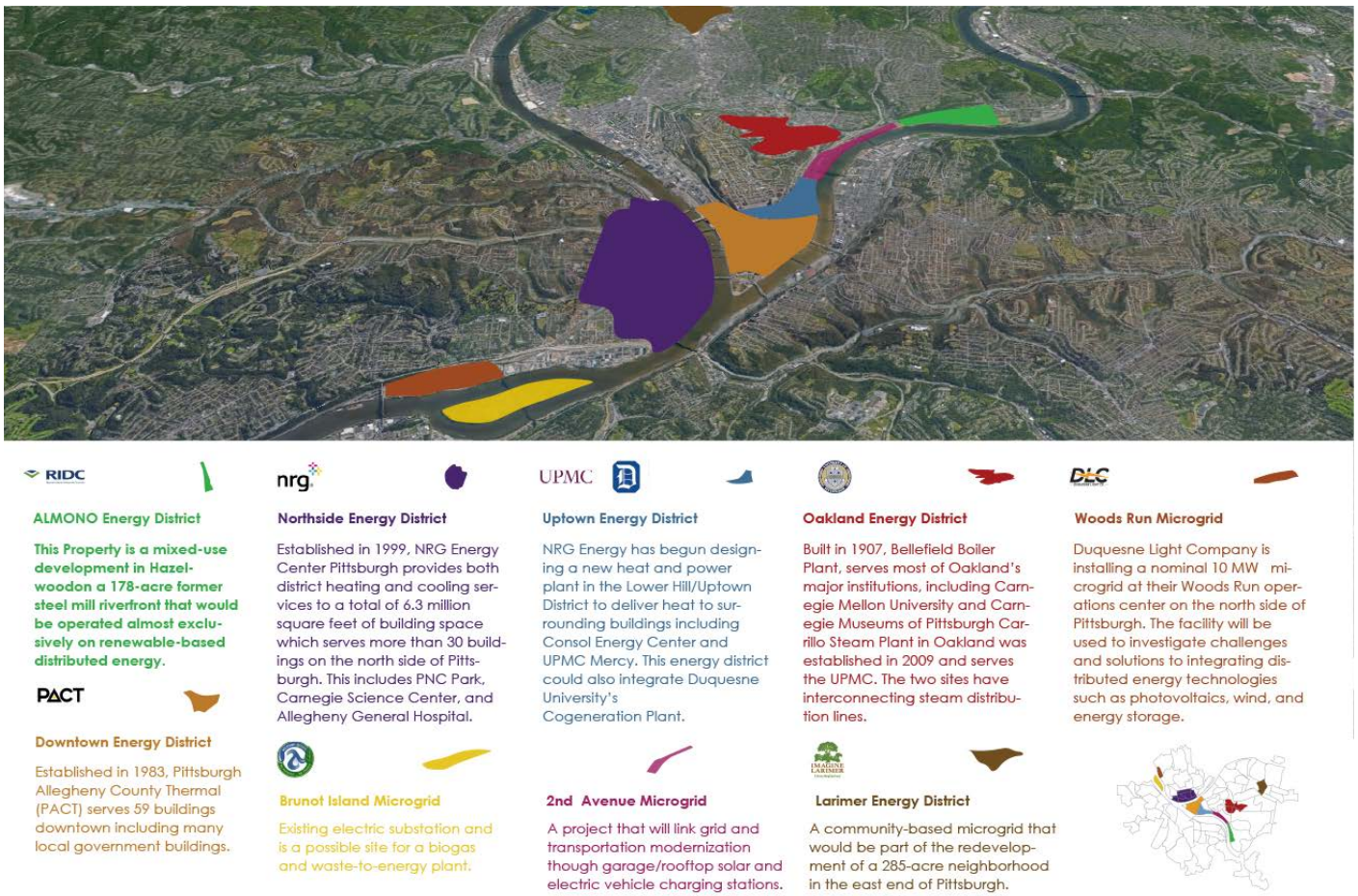

FIGURE 3. EXISTING DISTRIBUTED ENERGY SITES AND TO BE DEVELOPED MICROGRIGS AND ENERGY DISTRICTS

Benefits of Distributed Energy Systems

Having communities organized into districts that are served by locally produced low-carbon power can boost reliability and efficiency while significantly reducing environmental impacts compared with the traditional method of having power pulled from the larger older generation and distribution grid that is fed by distant power plants and long-range transmission lines.

Further, distributed energy or microgrids give communities and consumers a larger role in deciding how their energy is produced in terms of lower carbon electricity and allows customers to partake in demand-response, net metering, and other programs and initiatives designed to increase the efficient and cost-effective use of electricity.

Social responsibility and community engagement are cornerstones of the city's vision for how it will generate and distribute energy in the future. Learning from the experiences of New York City and elsewhere along the east coast from Superstorm Sandy, the proposed UPMC-Oakland microgrid would ensure that critical hospital and related emergency services will be provided and will serve as a safe haven for residents of the Oakland and surrounding communities to take shelter should there be a major disruption in the power grid in the Pittsburgh region.

From a community-engagement standpoint, the proposed Larimer microgrid would part of a larger revitalization of this economically and socially challenged neighborhood in Pittsburgh's East End and will build upon the significant land use planning and sustainability efforts of the community since 2012. Community-based solar offers a particularly attractive distributed energy opportunity for Larimer and other East End communities like Homewood.

MOTIVATION	BENEFIT	DESCRIPTION
INCREASED RELIABILITY	Modernize utility delivery	While efficient, the city's existing delivery system for electricity, steam, and hot/chilled water is aging and in need of modernization; microgrids will help strengthen the power system
	Improve power quality	Distributed energy systems can better provide customers with consistent quality electricity particularly during times of disturbances/disruptions of the grid
IMPROVED ECONOMICS	Encourage Workforce Development and job Creation	The creation of a grid of microgrids will further enhance and strengthen the city's existing electric power distribution infrastructure
	Build upon efficiency of existing grid	A modern energy generation and distribution network will create job and work-force training opportunities for both skilled and semi-skilled workers
	Drive economic development,growth and attract investment	A modern, efficient energy network will stimulate economic development and growth by attracting further investment in the city
ENHANCED SECURITY	Strengthen resiliency and security of energy delivery	A network of distributed energy systems that can operate independent of the existing grid will strengthen the city's energy resiliency and security
	Prepare for future catastrophic events	Microgrids that can be islanded (isolated) from the grid provide the ability to pro-vide power to critical buildings and infrastructure during catastrophic events such as "superstorms"
IMPROVED ENVIROMENTAL QUALITY	Reduce carbon footprint and improve environment	Distributed energy systems using a mix of renewable energy and natural gas coupled with efficiency improvements and waste heat recovery will reduce greenhouse gas emissions and improve overall environmental performance
ACCELERATED INOVATION	Advance new energy technologies	Microgrids and other distributed energy resources provide a venue for the research, development, demonstration, and deployment of advanced power technologies such as energy storage and advanced control systems
	Establish city as energy innovation hub	The creation of a "grid of microgrids" will make Pittsburgh a model for world and a hub for grid innovation and advancement
	Enhance city as place to live, work and visit	A cleaner, more reliable energy generation and delivery system will further enhance Pittsburgh reputation as a "most livable city" by having access to clean, reliable, and affordable power in their home

FIGURE 4. -- BENEFITS THAT THE CITY AND ITS RESIDENTS WILL ACCRUE ASSOCIATED WITH A NETWORK OF DISTRIBUTED ENERGY SYSTEMS

NETL Activities under the Scope of the MOU

NETL's MOU team have been meeting with city leaders and partners regularly on the project. In early May of this year, NETL Chief Financial Officer Jim Wilson joined project leaders and technical experts on a tour of three of the city's existing distributed energy facilities and explained that Laboratory experts intend to be an enabler for the city's vision. NETL helped the City of Pittsburgh become a partner in Office of Renewable Energy and Energy Efficiency (EERE) Combined Heat and Power (CHP) Resiliency Accelerator and arranged a visit to Pittsburgh by EERE's CHP Technical Assistance Partnership technical team. The delegation toured three of the city's existing combined heat and power/district heating resources: Duquesne University's Co-Gen Plant; NRG's North Shore Co-Gen Plant; and Pittsburgh Allegheny County Thermal plant that provides steam to downtown Pittsburgh.

"We try to be an enabler," Wilson told the Pittsburgh Post-Gazette during the tour. "We try to make sure that we're helping the city make connections, make sure the city is aware of various governmental resources, assisting them in putting together applications for funding, and helping them in any way we can." Wilson said the project is beneficial for NETL because it gives researchers an opportunity to demonstrate their considerable expertise. "We have a lot of bright people working on cutting-edge technology," he said. "We always have as a priority finding a way to get that intellectual capital out into the commercial market."

FIGURE 5. -- ARTIST RENDITION OF 400 SOFC INSTALLED AT NRG'S PITTSBURGH NORTH SHORE FACILITY

One NETL technology that will be demonstrated under the MOU is a solid oxide fuel cell (SOFC) being developed by Fuel Cell Corporation. This advanced technology coverts natural gas directly into electricity without combustion. Advantages of SOFC include high efficiency, long-term stability, fuel flexibility, and low emissions. The 400 kW SOFC unit will be installed and tested for 5000 hours at NRG's North Shore district energy facility in 2018 (Figure 5).

The Laboratory's experts are also working with DOE's Energy Systems and Policy Analysis team to help identify policy and regulatory challenges to developing a strong business case for implementing the City's "grid of microgrids" concept. For example, a key policy question for traditional electricity transmission and distribution utilities is how to recover their fixed costs as distributed energy and energy and efficiency initiatives expand.

While much has been accomplished since the MOU was signed on July 17, 2015, work remains to be done on the concept. The Clean Energy City of the Future "to do list" includes:

- Formulating a strategic plan to assist in the identification and adoption of district energy strategies and to provide guidance for public and private stakeholders on development of district-scale clean energy and grid design
- Identifying financial opportunities for the design and construction of district energy systems and renewable energy deployment

- Designing a policy plan that supports the development of municipal, utility, and regulatory policy needs for district energy applications and infrastructure modernization
- Conducting an economic analysis of district-energy solutions with microgrid integration and building performance policies
- Accelerating the growth of and access to energy jobs
- Creating a technical team to identify and prioritize high-value energy opportunities
- Developing a research and development roadmap for rapid demonstration and deployment of new technologies

The team assembled to execute the work is a "who's who" of Pittsburgh ingenuity and leadership in energy, research, and sustainability from across the city and region including the University of Pittsburgh's Center for Energy, Carnegie Mellon University, Duquesne Light, the University of Pittsburgh Medical Center, Peoples Gas, NRG Energy, the Hillman Foundation, Heinz Endowments, and the Richard King Mellon Foundation.

Communication and Outreach

As part of a communication and outreach strategy, NETL is working with the City to create a series of videos highlighting the MOU. A high-level video will provide a perspective on the vision and goals of the effort from Pittsburgh Mayor William Peduto, DOE Secretary Ernest Moniz, and NETL Director Grace Bochenek. A second video will present commentary on the MOU activities from a broad spectrum of regional stakeholders represented by Duquesne Light Company, Peoples Gas, Carnegie Mellon University, Urban Innovations, and ReMake Group. The third video will provide a more technical narrative about microgrids and distributed energy and includes insights from representatives of the University of Pittsburgh, NETL, and Duquesne Light Company. Once completed, the videos will be available through the NETL Internet and YouTube sites.

Federal Funding Opportunities

One of the critical MOU goals that NETL has been aggressively moving on is identifying financial opportunities to catalyze investment in distributed energy systems/micrgrids and supporting activities in the city. Financing is one of the bigger challenges for microgrids particularly in a region like Pittsburgh that is blessed with relatively low-cost, reliable electricity. Making a strong business case to build microgrids will require enumerating to investors the many, but often nuanced, advantages associated with distributed energy systems including increased resiliency and reduced environmental impacts. NETL is also playing a role in the early demonstration and deployment of advanced DER to help reduce the real and perceived risks to investors of new technology associated with microgrid systems. An example is the 400 kW_e SOFC that will be installed and tested at the NRG North Side facility.

Leveraging federal support with other public and private-sector funding is one approach to financing. NETL and DOE's Jobs Strategies Council within the Secretary's Office have been facilitating conversations between the City and DOE's Loan Program Office to discuss loan-based financing for one or more of the City's distributed energy systems.

NETL is also tapping into funding it has received from EERE's Geothermal Technology Office in working with the City to assess potential for direct use of geothermal energy from deep resources in the eastern

U.S. The ALMONO site appears to be an attractive opportunity to apply deep direct geothermal as part of its overall plan to have to operate a totally renewable-based microgrid.

NETL has identified a number of funding opportunities across a spectrum of federal programs including DOE's Office of Renewable Energy and Energy Efficiency (EERE) and Office of Electricity Delivery and Energy Reliability. In particular, NETL worked with the City and its partners in two recent Federal funding opportunities – the Department of Transportation's Smart City Challenge and DOE/EERE's Cities LEAP.

Smart City Challenge

NETL was an active partner in supporting Pittsburgh's pursuit of a $50 million Smart City Challenge grant from the U.S. Department of Transportation (DOT) to improve regional transportation. Plans call for development of a full range of diverse transportation elements that improve air quality, develop new manufacturing related to smart traffic signals and tracking devices, and help facilitate electric vehicle use. Powering of the city's electric vehicles would be accomplished through locally sourced distributed energy that would be developed under the MOU.

After having been named a finalist for the funding in March 2016, Pittsburgh became a competitor with six other cities for the grant: Austin, Texas; Columbus, Ohio; Denver, Colorado; Kansas City, Missouri; Portland, Oregon; and San Francisco, California. Pittsburgh officials made final presentations in support of the city's proposal in Washington, D.C. in June.

The successful city would receive $40 million from the Department of Transportation; $10 million from Paul G. Allen's Vulcan Inc.; $1 million in cloud service credits from Amazon Web Services; and additional funding from Mobileye, Autodesk and Alphabet's Sidewalk Labs.

The State of Pennsylvania provided the city with $11 million to support its application, which would be used to leverage other state or federal money to support the proposal to improve transportation and revitalize the economy.

The DOT announced that Columbus, Ohio won the Smart City Challenge in July, however, on October 11, 2016, the City received notice would receive a $10.9 million grant under the Fixing America's Surface Transportation Act (FAST Act). This grant is to be used to create "smart spines" that collect data through a network of sensors to help balance and move traffic through the city. In announcing the FAST Act funding, the DOT pointed to the strong proposal submitted by Pittsburgh for the Smart City Challenge as one reason for awarding the $10.9 million.

DOE Cities Leading through Energy Analysis and Planning

NETL also supported the city's application for funding under the DOE Office of Energy Efficiency and Renewable Energy (EERE) Cities Leading through Energy Analsis and Planning (Cities-LEAP) project, which is an effort to help cities set climate goals and priorities for energy strategies, and make data-driven energy decisions. Researchers from the Laboratory's Energy Data eXchange (EDX) were partners in the proposal submitted by the city to EERE.

It was announced on August 11 that three projects were selected under the Cities LEAP program: the City of Bellevue, Washington, the City of Portland, Oregon, and the Upper Coastal Plan Council for Governments in North Carolina.

NETL has also introduced the City to DOE/EERE's Community Solar Challenge that has recently issued a Request for Information to solicit feedback and comments on a program to facilitate community solar projects with a focus on low- and moderate-income communities. EERE will use this feedback to structure a competitive action to provide support for expanding community solar initiatives. Such a program would have potential application to Larimer, Homewood, and other Pittsburgh communities.

City Actively Engaged in Climate Action

The City has been aggressively pursuing a broad spectrum of climate and energy efficiency programs since the mid-2000 that align with the goals of the MOU. These programs and activities are described below.

Pittsburgh Climate Initiative

The Pittsburgh Climate Initiative (PCI) was founded in 2008 following adoption of the City's inaugural Climate Action Plan. PCI is a collaborative involving City and County government, non-profits, higher education, and the business community. While the PCI was initially convened by non-profit organizational partners, in 2015 the City of Pittsburgh's Office of Sustainability assumed more of a leadership role. In this way, the greenhouse gas inventories and climate action plans completed by PCI are integrated into other planning efforts like the Comprehensive Plan and Resiliency Planning.

2030 Districts

2030 Districts® were formed across North America to meet energy, water and vehicle emissions reduction targets for existing buildings and new construction. The Pittsburgh 2030 District, a strategic initiative of Green Building Alliance with boundaries in Downtown Pittsburgh and Oakland, has met and exceeded all three reduction targets – energy, water, and transportation emissions. The Pittsburgh 2030 District has reduced its total energy and water consumption by 12.5 percent and 10.3 percent, respectively, surpassing its 2015 goal of 10 percent. It also reported a reduction in transportation emissions by 24.2 percent, exceeding its 2020 goal of a 20 percent reduction – five years early. The District, which collects and aggregates actual performance data from committed buildings within its two District boundaries, is the largest of 12 internationally recognized 2030 District cities and is the first to report that the incremental goals have been achieved and surpassed.

100 Resilient Cities Network

The 100 Resilient Cities organization is dedicated to helping cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the 21st century and supports the adoption and incorporation of resilience planning and innovation that includes earthquakes, fires, floods, as well as other stresses that weaken cities like high unemployment, overtaxed or inefficient public transportation systems, violence, or chronic food and water shortages. By participating in activities and using resources of the network, Pittsburgh has focused on mitigating challenges created by severe weather events, such as blizzards and heavy rains. The city plans to concentrate future planning efforts on a flood management system and the expansion of green infrastructure.

DOE Pittsburgh Region Clean Cities

Nearly 100 local coalitions comprise the Clean Cities program, which work to cut petroleum use in communities across the country. Clean Cities coalitions are made up of local businesses, fuel providers, vehicle fleets, state and local government agencies, and community organizations. Each coalition is led by an on-the-ground Clean Cities coordinator, who tailors projects and activities to capitalize on the unique opportunities in their communities.

The program leverages resources to create networks of local stakeholders that provide technical assistance to fleets implementing alternative and renewable fuels, idle-reduction measures, fuel economy improvements, and emerging transportation technologies.

The Pittsburgh Region Clean Cities works with vehicle fleets, fuel providers, community leaders, and other stakeholders to reduce petroleum use in transportation. In Pittsburgh, the program supports establishments of alternative fueling stations.

ICLEI—Local Governments for Sustainability

The City is an active member of ICLEI, the world's leading network of cities, and towns committed to building sustainable futures. The organization helps make cities attain sustainable, low-carbon, resilient, ecomobile, biodiverse, resource-efficient, productive, healthy and happy, future with a green economy and a smart infrastructure.

Urban Sustainability Directors Network

Pittsburgh participates in the Urban Sustainability Directors Network is a peer-to-peer network of local government professionals from cities across the United States and Canada dedicated to creating a healthier environment, economic prosperity, and increased social equity. The network enables sustainability directors and staff to share best practices and accelerate the application of good ideas.

CDP

Over the past five years, CDP has worked with more than 300 cities including Pittsburgh to manage more than 1.67 billion metric tonnes of greenhouse gas emissions. CDP's cities program demonstrates that cities are better managing their risk and increasing resiliency through more than 4,800 activities to mitigate and adapt to climate change. Pittsburgh is an active participant in CDP activities.

EcoDistricts

Pittsburgh is a participant in the program through an integrated suite of programs, learning experiences and project certification tools, EcoDistricts assists cities with urban regeneration. The organization has developed the unique EcoDistricts Protocol, a first-of-its-kind, holistic project development framework that makes addressing these challenges achievable.

The City Energy Project

The City Energy Project is a national initiative to create healthier and more prosperous American cities by improving the energy efficiency of buildings. Working in partnership, the Project and cities will support innovative, practical solutions that cut energy waste, boost local economies, and reduce harmful pollution. The pioneering actions of the 10 cities involved in the City Energy Project will be models for communities around the world.

NIST Global Cities Challenge

The Challenge helps communities address issues ranging from air quality to traffic management to emergency services coordination. NIST helped organize communities like Pittsburgh and innovators to create teams that will foster the spread of "smart cities" that take advantage of networked technologies to better manage resources and improve quality of life. Collaborations occur on a range of issues from disaster response to energy management to mass transit improvement.
Engagement with Other Pennsylvania Microgrid Projects.

The MOU team has initiated interactions with microgrid projects in Reading, Philadelphia, and other locations in Pennsylvania. A primary purpose of this engagement is identify opportunities for collaboration with the Pennsylvania Department of Community and Economic Development and the Department of Environmental Protection. In Reading, the Berks County Industrial Development Authority is developing plans for a microgrid on a 155 acre brownfield site adjacent to the Reading airport. The proposed microgrid would include CHP, photovoltaics, and battery storage. NETL, DOE, and the University of Pittsburgh participated in a planning meeting for the BCIDA microgrid in Reading on July 28, 2016.

The Philadelphia Industrial Development Corporation is leading in development of The Navy Yard, a 1,200-acre urban campus on the site of the former Philadelphia Naval Shipyard. In 2014, PIDC began an update of the energy infrastructure at The Navy Yard to improve the management of power delivery. PIDC has engaged a consortium of partners, including PECO, Penn State, GE Grid Solutions, PJM, DTE Energy, and several additional private sector partners to establish The Navy Yard as a national center for emerging smart grid and distributed generation policies, practices and technologies. A meeting was held on July 14th at the Navy Yard where a presentation on the City of Pittsburgh MOU was made.

CONCLUSION AND FUTURE WORK

When NETL signed a Memorandum of Understanding with the City of Pittsburgh, it agreed to help its home town undertake a series of important activities geared toward meeting the region's future energy needs. Key goals include:

- Creating socially responsible networks of distributed energy generation systems to increase resiliency, reduce carbon foot print, and improve efficiency
- Providing a platform to accelerate adoption of advanced distributed energy resources such as microturbines, direct current power delivery systems, CHP reciprocating engines, energy storage devices, photovoltaics, and wind turbines
- Coupling advanced, smart, and socially responsible transportation infrastructures with power supplied by locally generated energy sources
- Achieving the goals and objectives set forth in the City's Climate Action Plan 3.0

In pursuing these goals, the Laboratory has assisted the City on a range of activities including:

- Facilitating conversations between the City and DOE's Loan Program Office in pursuit of financing opportunities for one or more of the City's distributed energy systems
- Working with the City on participation in DOE's Geothermal Technologies Office program to assess potential for direct use of geothermal energy from deep resources in the eastern U.S.

- Collaborating with DOE EPSA on identifying key policy and regulatory barriers to implementing the city's "grid of microgrids" concept and facilitated workshops related to the City's climate action plan
- Coordinating outreach with the Pennsylvania Departments of Environmental Protection and Community and Economic Development and collaboration with other microgrid developments in the state
- Creating a series of educational videos highlighting the overall vision and goals of the MOU

NETL will continue to partner with the City to help make Pittsburgh a Clean Energy City of the Future while fulfilling the Laboratory's mission to discover, integrate, and mature technology solutions to enhance the nation's energy foundation and protect the environment for future generations.

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