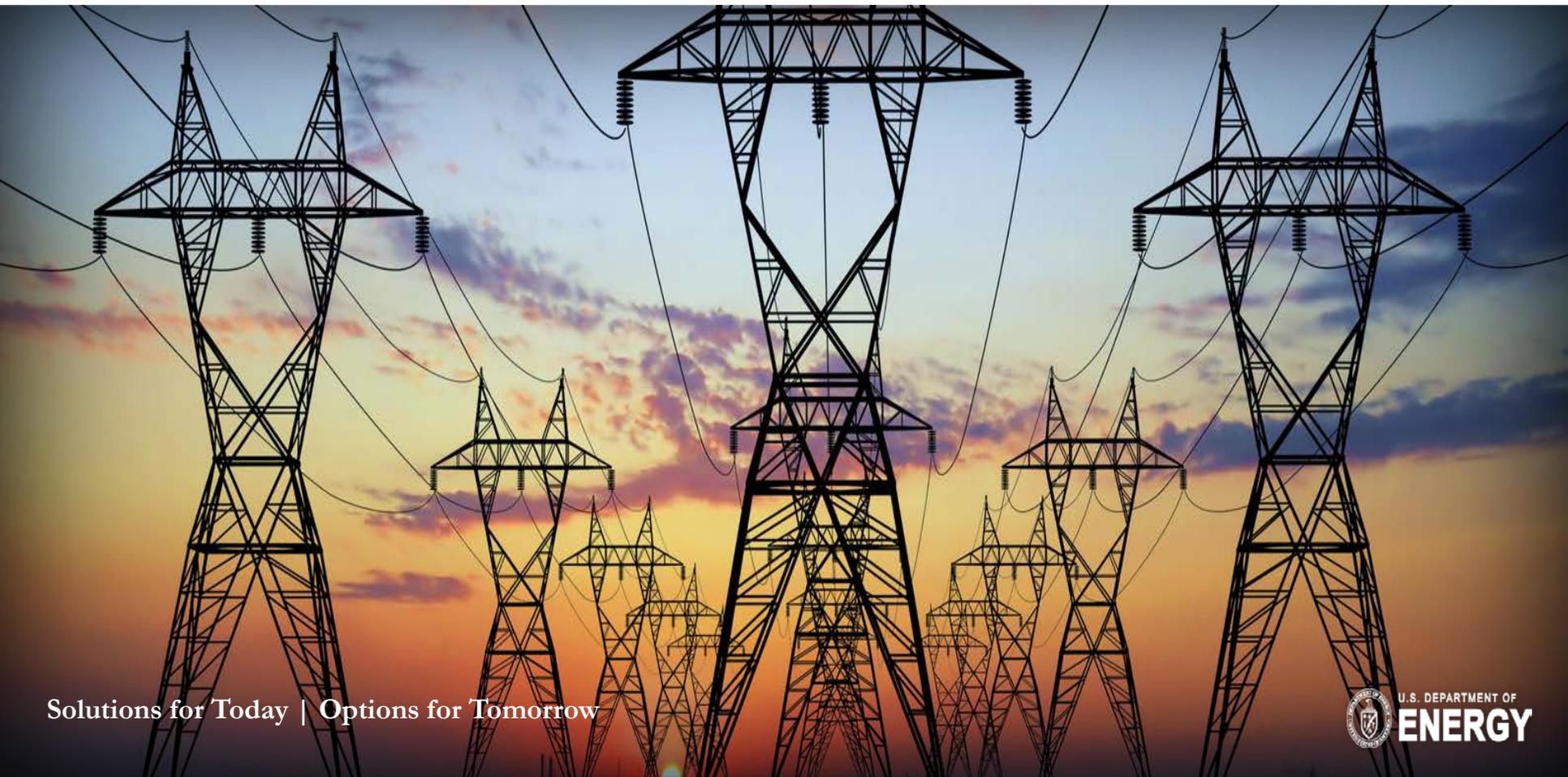


DOE/NETL-City of Pittsburgh MOU

Creating Pittsburgh's Energy Future Today



MOU Overview
December 2016



Solutions for Today | Options for Tomorrow



Celebrating Pittsburgh's Bicentennial



A Shared History

Memorandum of Understanding

- **Between U.S. Department of Energy/
National Energy Technology
Laboratory and City of Pittsburgh**
- **Signed on July 17, 2015**
- **Work jointly to design 21st Century
Energy Infrastructure to demonstrate
Pittsburgh as “City of Future” with
attendant environmental, economic,
and job-creation benefits**
- **Create multiple energy districts
 (“network of microgrids”) throughout
the City**



NETL Director Dr. Grace Bochenek and
City of Pittsburgh Mayor Bill Peduto sign
MOU on July 17, 2015 at Energy
Innovation Center

MOU Overall Objectives



- **Create socially responsible network of distributed energy districts/microgrids to increase resiliency and sustainability, reduce carbon footprint, and improve energy efficiency**
- **Three general categories of energy districts under development: (1) industrial/commercial; (2) critical infrastructure; and (3) community oriented**
- **Provide platform to accelerate adoption of distributed energy resources such as microturbines, reciprocating engines, fuel cells, photovoltaics, wind turbines, energy storage devices (e.g., batteries), AC/DC hybrid power delivery, CHP and smart grid technologies**
- **Couple with advanced, smart, and socially responsible transportation infrastructure powered by locally generated energy**

Pittsburgh Can Serve as a National Model for Microgrids...



...through demonstration of:

- **Existing Systems** – Retrofitting and reconfiguring of existing distributed energy resources in North Side, Oakland, and Downtown are models for mature cities with aging grids and networks.
- **New Developments** – Development opportunities along Pittsburgh’s rivers such as ALMONO and in underserved communities are models for diversified clean energy resource development and advanced delivery infrastructure and community engagement.
- **Hybrid Approaches** -- Opportunities in Lower Hill District and Uptown Corridor are models for integrating advanced energy technology solutions with existing infrastructure.

Under the MOU NETL Will

- **Provide technical support, e.g.,:**
 - Geothermal energy potential assessment of one of microgrids
 - Technology roadmapping
 - Energy use and emissions baselining
- **Demonstrate NETL funded SOFC technology**
- **Identify funding opportunities such as federal FOAs and non-federal funding**
- **Support development of Request for Information**
- **Coordinate overall management of MOU**
- **Engage key national, regional, and local stakeholders, e,g, PADEP, PAPUC**



A Shared History

Specific MOU Goals

- 1. Craft strategic plan supporting distributed energy strategies;**
- 2. Identify financial opportunities to catalyze investment in distributed energy systems and supporting activities;**
- 3. Address policy and regulatory needs for distributed energy and infrastructure modernization;**
- 4. Conduct economic analysis of cost/benefits of distributed energy with micro-grid integration and building performance policies;**
- 5. Accelerate growth and access to energy jobs;**
- 6. Form technical team to explore Pittsburgh's efforts; and**
- 7. Prepare technology R&D roadmap for rapid demo and deployment.**

MOU Partners



- City of Pittsburgh
- DOE/NETL
- University of Pittsburgh
- RK Mellon Foundation
- Heinz Endowment
- Hillman Foundation
- Duquesne Light
- Peoples Gas
- University of Pittsburgh Medical Center
- National Academy of Sciences
- NRG Energy
- RAND Corporation
- Oxford Development



Pittsburgh, PA

City of Pittsburgh Involved in Number of Resiliency and Sustainability Programs



- Energy Star Program
- Pittsburgh Climate Action Plan 3.0
- 2030 Districts®
- 100 Resilient Cities Network
- DOE Pittsburgh Region Clean Cities
- ICLEI – Local Governments for Sustainability
- Urban Sustainability Directors Network
- CDP
- EcoDistricts
- NIST Global Cities Challenge
- City Energy Project (NRDC & IMT)



Microgrid Benefits



INCREASED RELIABILITY

Modernize utility delivery

Improve power quality



IMPROVED ENVIRONMENTAL QUALITY

Reduce carbon footprint
and improve environment



ENHANCED SECURITY

Strengthen resiliency and
security of energy delivery

Prepare for future
catastrophic events



ACCELERATED INNOVATION

Advance new energy technologies

Establish city as energy
innovation hub

Enhance city as place
to live, work and visit



IMPROVED ECONOMICS

Encourage Workforce
Development and job Creation

Build upon efficiency
of existing grid

Drive economic development,
growth and attract investment



Microgrid Challenges in Pittsburgh

- Relatively low cost of electric power
- More than half of electricity is carbon-free nuclear power
- Relatively high reliability
- Need to develop business case
- Project financing
- Local provider is distribution-only utility
- Agreeing on motivation factors
- Current public utility policies and regulations
- Community awareness and support



Pittsburgh, “City of Bridges”

Pittsburgh's Proposed Microgrids/Energy Districts



Northside Energy District

Established in 1999, NRG Energy Center Pittsburgh provides both district heating and cooling services to a total of 6.3 million square feet of building space which serves more than 30 buildings on the north side of Pittsburgh. This includes PNC Park, Carnegie Science Center, and Allegheny General Hospital.



UPMC

Uptown Energy District

NRG Energy has begun designing a new heat and power plant in the Lower Hill/Uptown District to deliver heat to surrounding buildings including Consol Energy Center and UPMC Mercy. This energy district could also integrate Duquesne University's Cogeneration Plant.



CARNEGIE MUSEUMS OF PITTSBURGH
Four district resources

Oakland Energy District

Built in 1907, Bellefield Boiler Plant, serves most of Oakland's major institutions, including Carnegie Mellon University and Carnegie Museums of Pittsburgh Carrillo Steam Plant in Oakland was established in 2009 and serves the UPMC. The two sites have interconnecting steam distribution lines.

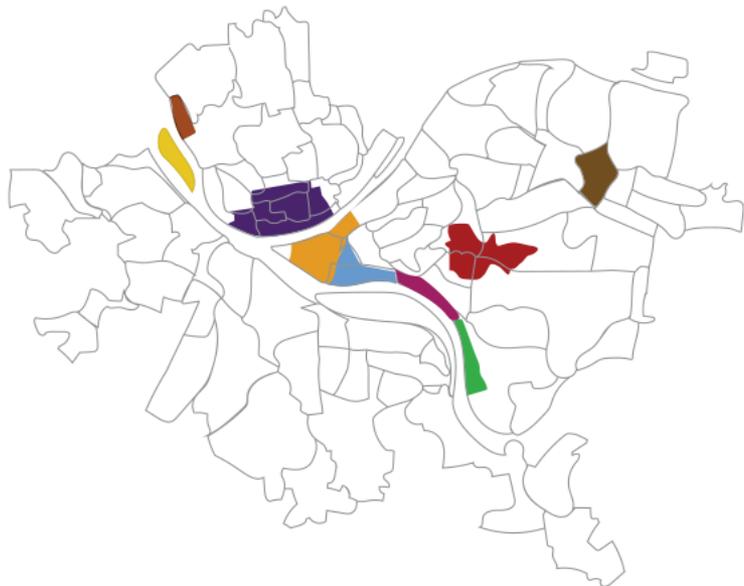


Downtown Energy District

Established in 1983, Pittsburgh Allegheny County Thermal (PACT) serves 59 buildings downtown including many local government buildings.

THE PITTSBURGH DISTRICT ENERGY VISION

"Creating Pittsburgh's Energy Future Today"



Almona



ALMONA Energy District

This Property is a mixed-use development in Hazelwoodon a 178-acre former steel mill river-front that would be operated almost exclusively on renewable-based distributed energy.



Larimer Energy District

A community-based microgrid that would be part of the redevelopment of a 285-acre neighborhood in the east end of Pittsburgh.



Brunot Island Microgrid

Existing electric substation and is a possible site for a biogas and waste-to-energy plant.



Woods Run Microgrid

Duquesne Light Company is installing a nominal 10 MW^e microgrid at their Woods Run operations center on the north side of Pittsburgh. The facility will be used to investigate challenges and solutions to integrating distributed energy technologies such as photovoltaics, wind, and energy storage.

2nd Avenue Microgrid

A project that will link grid and transportation modernization though garage/rooftop solar and electric vehicle charging stations.



Categories of Microgrids/Energy Districts in Pittsburgh

Industrial/Commercial

- PACT
- Woods Run
- ALMONO
- UPMC-Mercy Uptown
- NRG North Side
- Brunot Island

Social/Critical Infrastructure

- UPMC-Oakland
- 2nd Avenue

Community Based

- Homewood
- Larimer
- UPMC-Mercy/Uptown



Status of Microgrid Projects

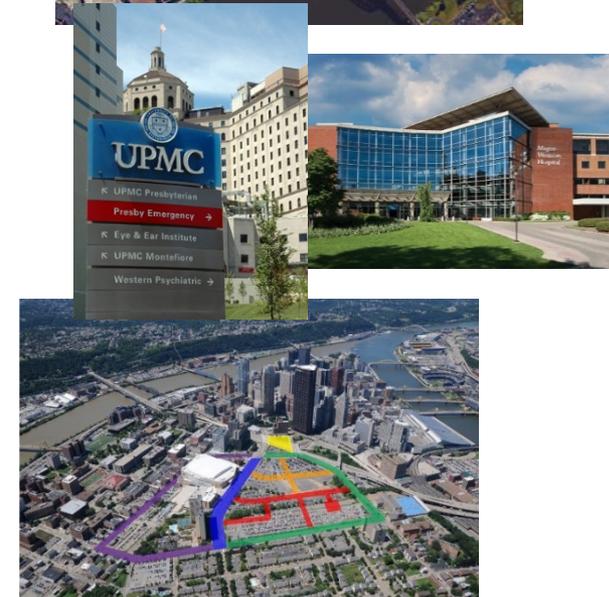
Duquesne Light Woods Run Facility

- Install, subject to regulatory approval, a nominal 2 MW microgrid at DLC's Woods Run operations campus on the north shore of Pittsburgh. In addition to providing resiliency to operations campus, installation is intended to be used to investigate challenges and solutions to integrating distributed energy technologies, such as photovoltaics, wind, and energy storage.
- Build phase Q1-3 CY18; operational by Q4 CY18



UPMC Oakland Social Responsible Microgrid

- Design microgrid concept based on ultra-high resiliency and reliability and considering societal issues of community and situational stability
- Project feasibility and design study proposal completed Q2 CY16 and submitted to DOE



Uptown District Energy Center

- 28 acre Lower Hill redevelopment
- NRG and UPMC-Mercy signed agreement in June to proceed with 1st phase of development to include a n.g. steam plant to supply steam, chilled water, and backup electricity
- City Council approved \$61 M project early September

Status of Microgrid Projects

2nd Avenue Energy District

- Garage/rooftop solar
- Electric vehicle charging stations
- Linking grid and transportation modernization

Larimer Energy Project

- 0.5 sq. mile community in East End
- Economically challenged neighborhood
- Recently completed Community and Land Use Vision Plan
- Potential opportunity for community-based solar and/or other renewable and low-carbon DER



Artist Rendition of Larimer Redevelopment

ALMONO Innovation District

- 178 acre former LTV steel brownfield site
- Mixed-use development
- Significant green energy; targeting 100% renewable
- NETL investigating deep direct geothermal potential
- Various state funding for phase I infrastructure work
- <http://almono.org/>

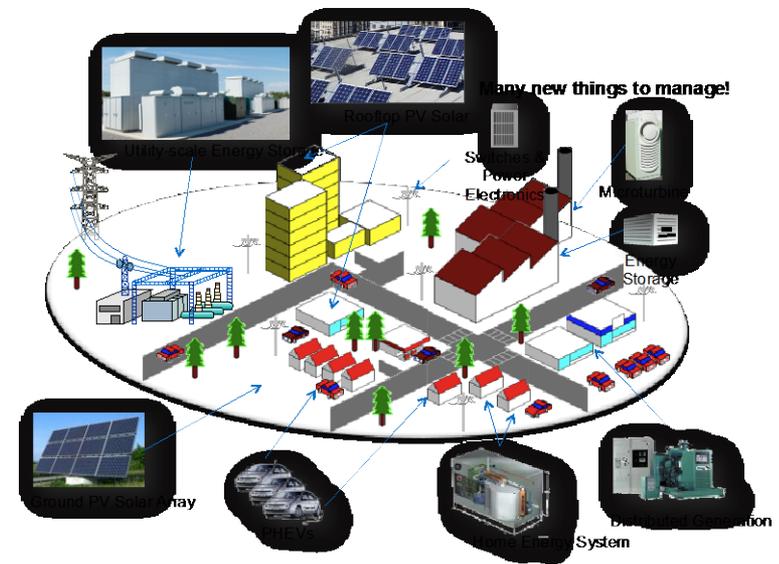


Aerial View of ALMONO site

What is a Microgrid?

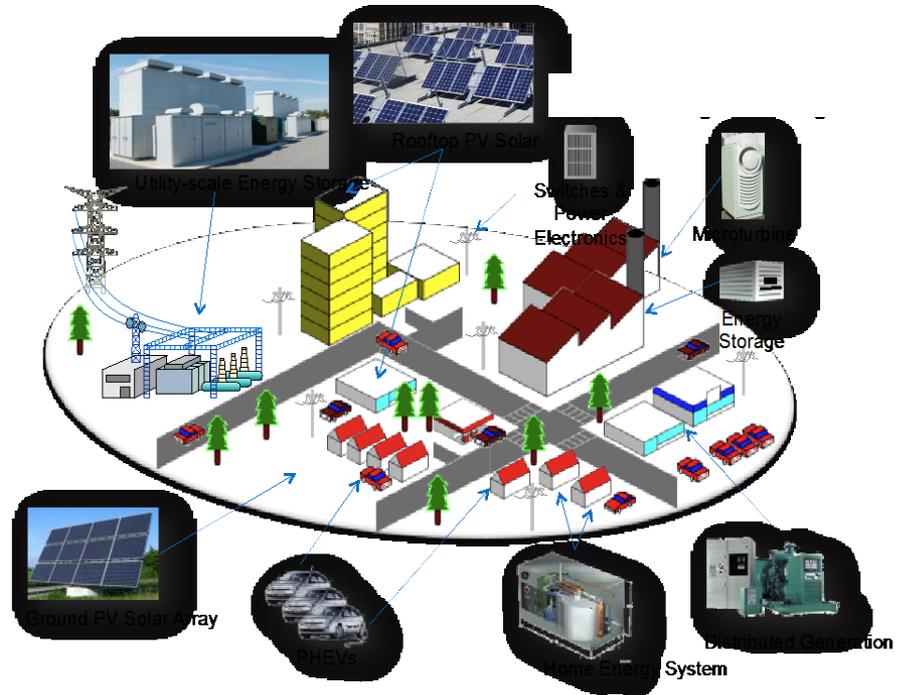
According to the DOE:

- Microgrid is group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to grid. Microgrids can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode.
- Island mode is an operating configuration where the microgrid assets are electrically isolated from the main power grid.



MOU To Serve as Test Platform for DER Technologies

- CHP
- Microturbines
- Internal combustion engines
- Fuel cells
- Photovoltaic (PV) arrays
- Wind turbines
- Small hydro systems
- Batteries
- Thermal storage
- DC technology



Source: Green Energy Corp.

NETL Partnership Activities

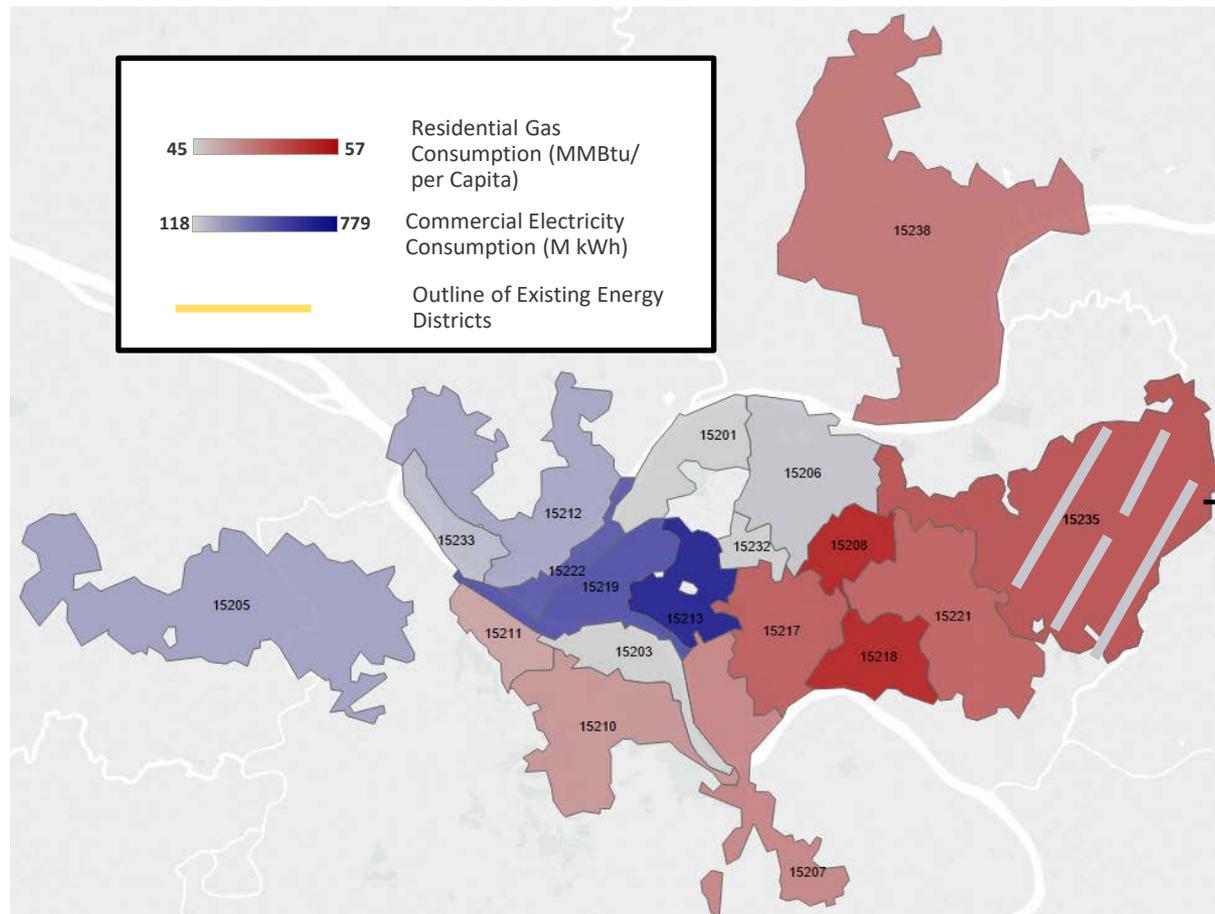
MOU Serves as Test Platform for Advanced DER

- NETL Funded project
- Developer: FuelCell Energy
- Test Site: NRG Energy Center, Northside
- Two 200 kW_e SOFC power systems
- Natural gas fueled
- Target operating time: 5,000 hours



Artist rendition of 200 kW_e SOFC system to be demonstrated at NRG's Northside Thermal Plant in 2018

NETL Providing Baseline City Energy Use Assessment

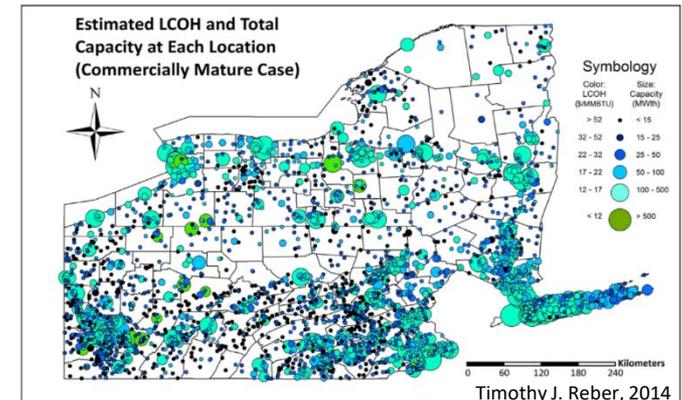


15235 is only zip code that is both top 10 in residential gas consumption per capita (3rd) and commercial electricity consumption (8th)

NETL's preliminary analysis suggest high energy demand in Pittsburgh's Strip District and Lawrenceville neighborhoods that could be considered potential locations for microgrids or energy districts.

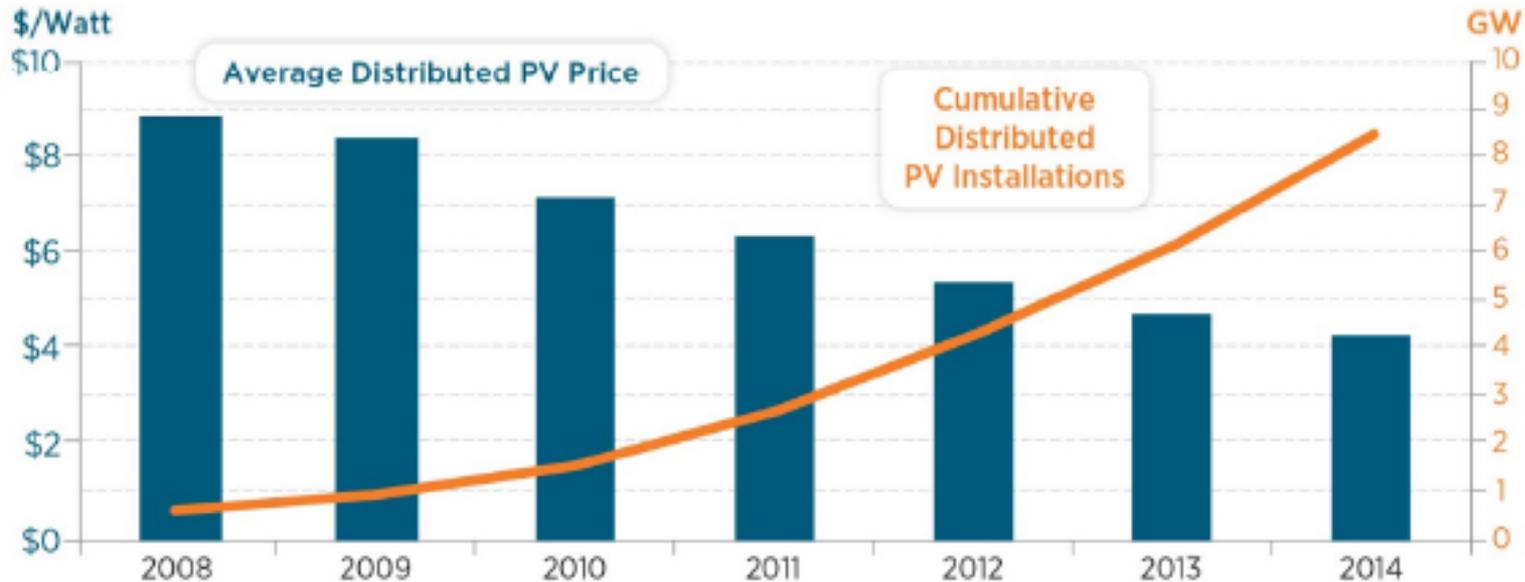
NETL Assessing Deep Geothermal Potential

- DOE's Geothermal Technology Office has initiated efforts to assess deep direct use (DDU) geothermal energy in Eastern U.S.
- NETL conducting a techno-economic study of opportunities for DDU geothermal energy extraction and use at ALMONO microgrid site.
- Analysis shows a lifetime capacity of up to 53 years when accessing the available deep (14,000 ft) geothermal resource.
- Preliminary results indicate lower geothermal potential than indicated by previous assessments. However, DDU geothermal energy could be viable at ALMONO under future economic and market conditions where fossil energy alternatives are more expensive, or when well development costs have been reduced. The latter is a subject of on-going NETL research.



Distributed/Community (Shared) Solar

Solar PV: Distributed Generation

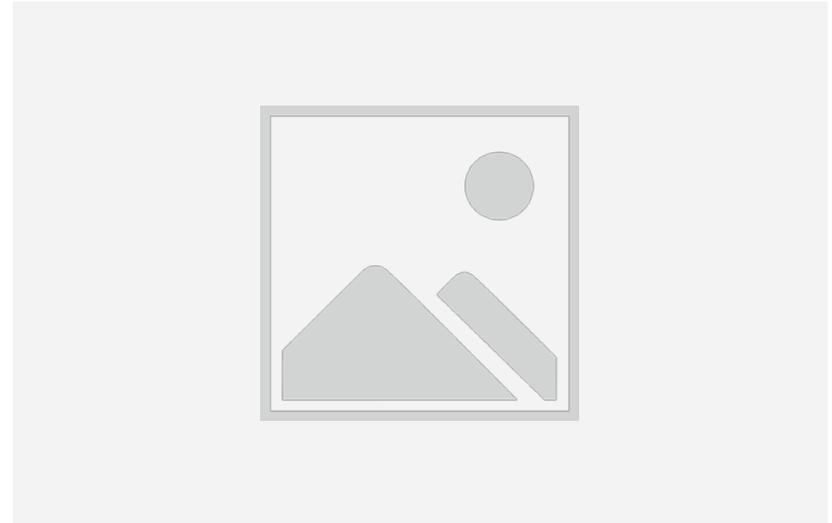


Notes: All prices are in $\$/W_{DC}$ and inflation adjusted to dollar year 2014. 1 gigawatt (GW) = 1,000 megawatts (MW). Capacity weighted average as reported by market report for residential systems only.³² Non-residential systems are typically larger and have lower reported prices. Capacity is cumulative distributed residential and non-residential capacity, in GW_{DC} .³³

Source: DOE Report, *Revolution...Now: The Future Arrives for Clean Energy Technologies – 2015 Update*

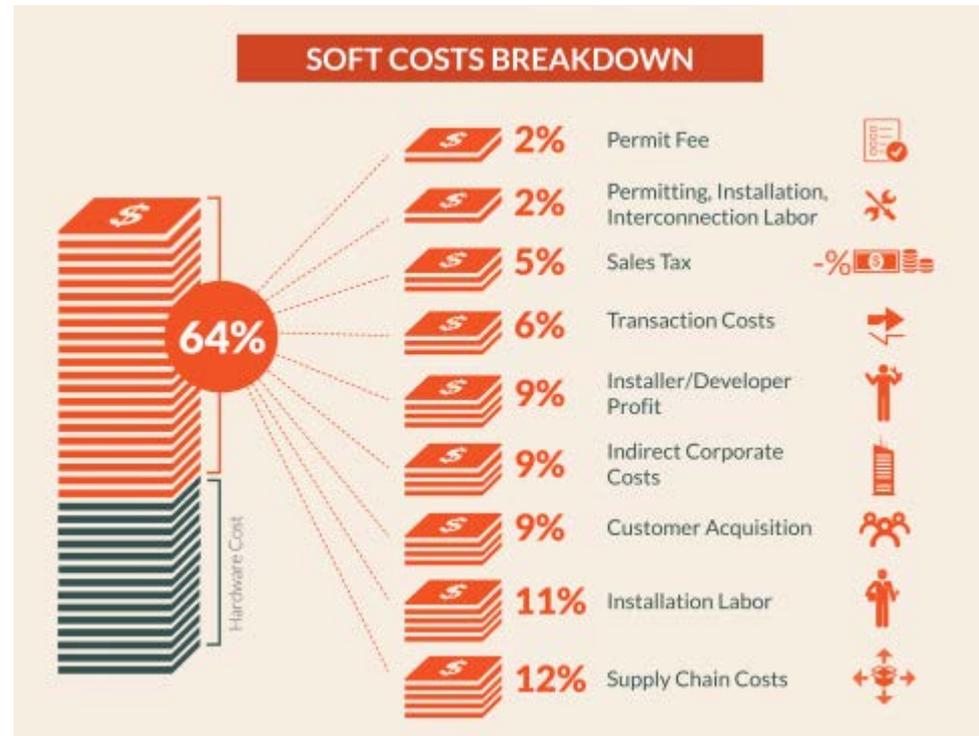
Solar Partnership/Outreach Opportunities

- **Opportunities for City to engage in/ coordinate with:**
 - PADEP’s efforts under DOE’s SunShot Program to employ detailed scenario modeling to analyze current solar developments and legislation and determine how they will be applied in 2030 under scenario where up to 10 percent of electricity sales are from solar generation.
 - DOE SunShot’s SolSmart program that provides technical assistance for local governments to help drive greater solar deployment.
- **Both programs address solar energy “soft costs” or non-hardware costs through work on strategic topics such as permitting, financing, training, and data analysis**



Solar “Soft Costs”

- Soft, or non-hardware costs, account for as much as 64% of new solar projects according to DOE’s SunShot solar program.



Source: DOE/EERE SunShot Program

Opportunity to Engage Local Corporate Support

- Google has committed worldwide to purchase nearly 2.5 GW of renewable energy, and to invest nearly \$2.5 billion in renewable energy projects.
- Google has invested \$75 million to create Clean Power Finance to support distributed/rooftop solar.
- Google-Pittsburgh has expressed an interest in community solar initiatives in underserved Larimer and Homewood neighborhoods.
- Discussions with Google continuing



Artist Rendition of
Larimer Redevelopment

City of Pittsburgh Receives DOT Grant

- DOT Secretary Anthony Foxx announced that Pittsburgh will receive nearly \$11 million to execute elements of the vision it developed in its Smart City Challenge application, including deployment of smart traffic signal technology – proven to reduce congestion at street lights by up to forty percent – along major travel corridors.
- Grant is part of DOT’s Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program.



Pittsburgh, Pennsylvania

Outreach and Communications

- YouTube videos about MOU can be found at:
 - Stakeholder video:
<https://youtu.be/5t9iqW19LQ8>
 - Technical video:
https://youtu.be/wyJ4Z_7psqE



A Shared History

Ongoing Activities



- **NETL, City of Pittsburgh, and University of Pittsburgh crafting Request for Information template to be used for one or more of the proposed microgrids/energy districts**
- **Initiating dialogue with PA Public Utility Commission on regulatory and policy issues affecting microgrids and distributed energy**
- **Continuing conversation with foundations and corporate neighbors on supporting community-based energy districts**

For more information contact

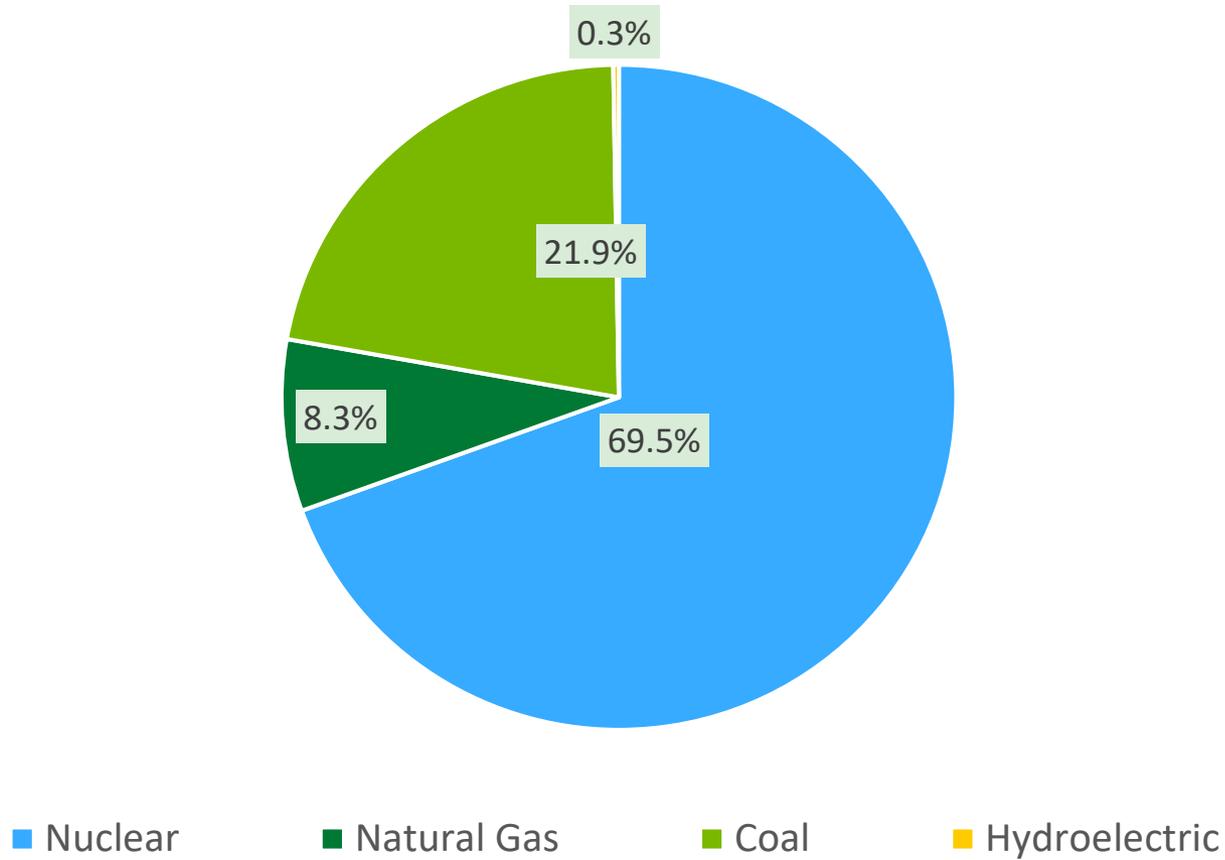
- **Thomas J. Tarka P.E.**
Senior Engineer
U.S. Department of Energy
National Energy Technology Laboratory
thomas.tarka@netl.doe.gov
412.386.5434
- **Hillary Bright**
U.S. Department of Energy
Economic Development Specialist Jobs
Strategy Council
hillary.bright@ee.doe.gov 202.420.064
1
- **Grant Ervin**
Sustainability Manager
Mayor's Office
City of Pittsburgh
grant.ervin@pittsburghpa.gov 412.255.
2255



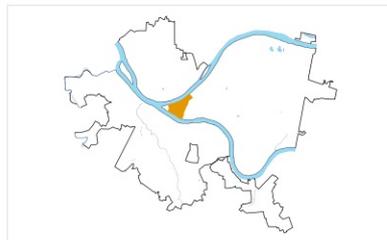
Backup Slides

Generation Mix – City of Pittsburgh

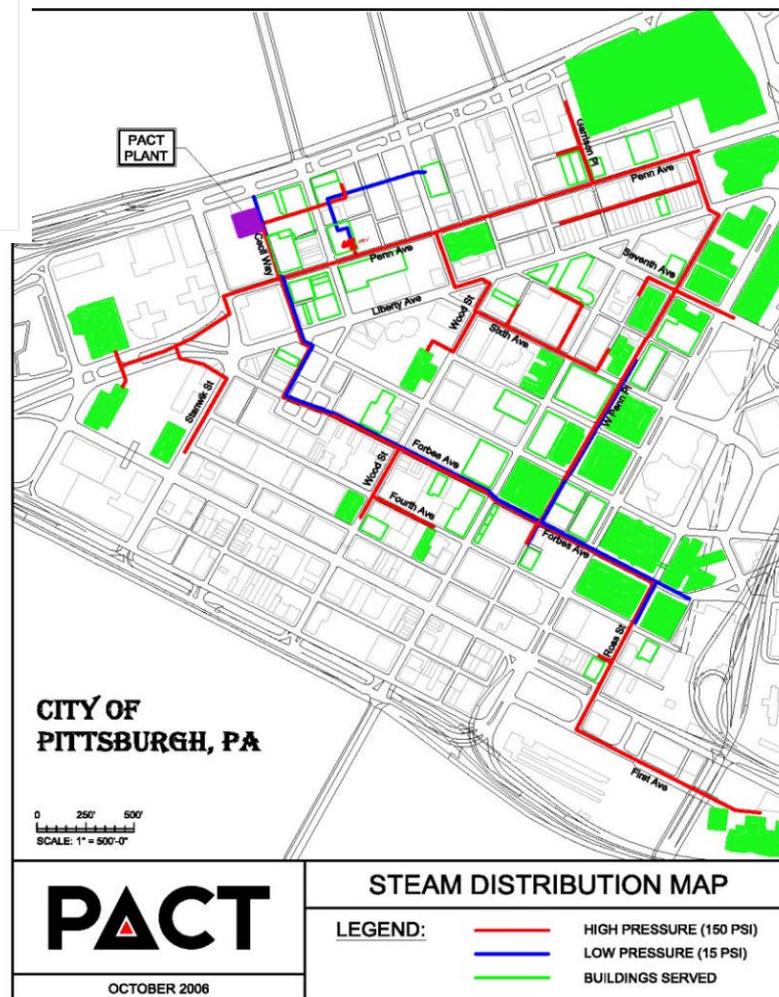
Generators with DLC Territory



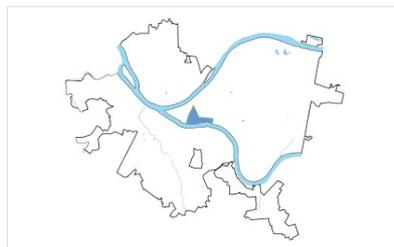
PACT



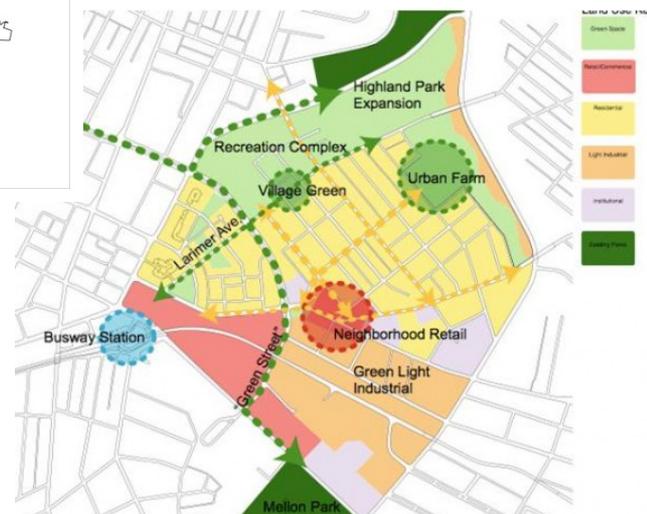
- Established in 1983
- 59 buildings currently on the system, including many local government buildings
- Customer owned
- Capacity
 - 500,000 lbs/hour of steam



Larimer Energy District



- 285 acre choice neighborhood
- Mixed use development
- 1,728 residents
- District energy opportunities including community solar



Artist Rendition of Larimer Redevelopment



Northside Distributed Energy

- Operated by NRG
- More than 30 buildings including Allegheny General
- Over 6.3 million square feet
- Capacity
 - 240 Mlbs/hour of steam
 - 20.4 MMBtu/hour of hot water
 - 12,580 tons of chilled water
- Plans for electric generation
- Demonstrate 200 kW_e Solid Oxide Fuel Cell in 2018

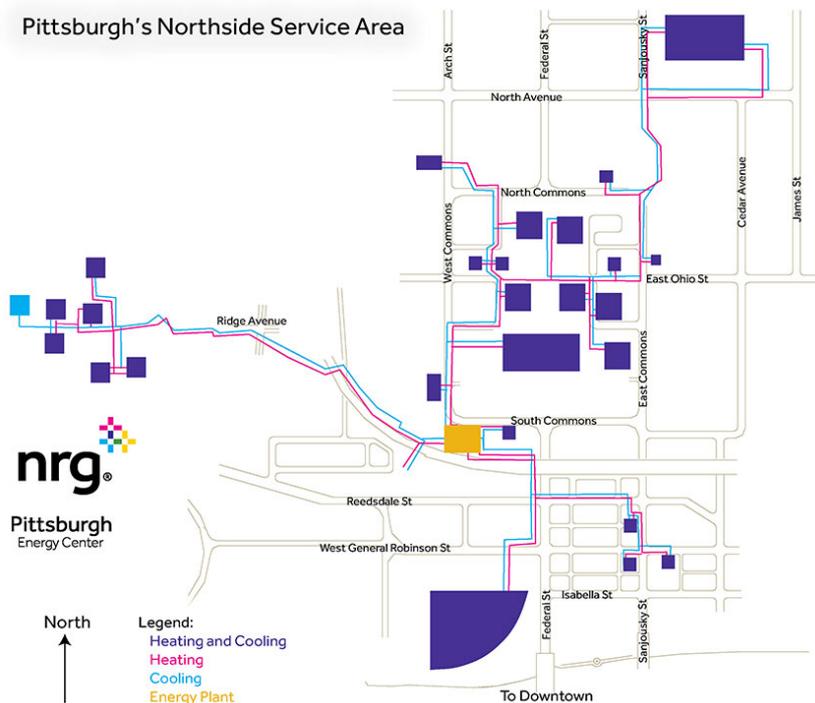
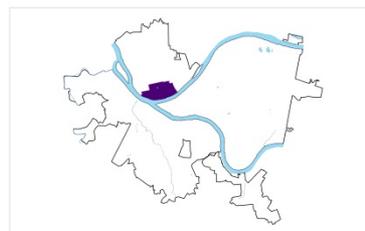


Image Source: NRG

ALMONO Energy District

- 178 acre riverfront property
- Former LTV steel plant
- Mixed-use development
- Clean industry
- Applied research & innovation

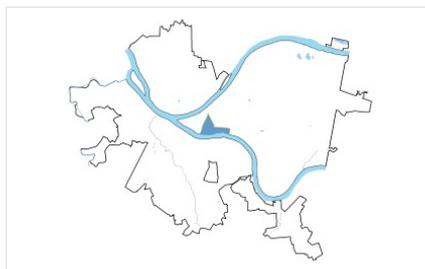


Image Source: ALMONO



Aerial View of ALMONO



Former LTV Mill at ALMONO

Bellefield Boiler Plant

CARNEGIE | MUSEUMS
OF PITTSBURGH

- Built in 1907
- Serves most of Oakland's major institutions
- Capacity
 - 460,000 lbs/hour of steam
- Interconnected with Carrillo steam distribution lines

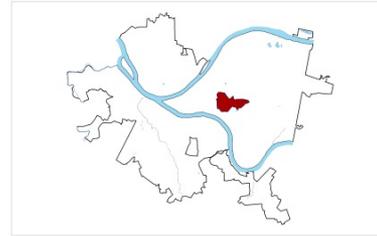
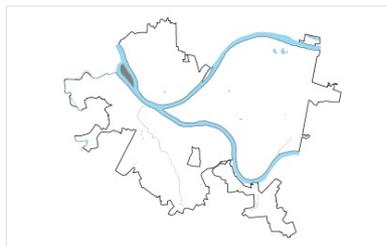


Image Source: Margaret J. Kraus, 90.5 WESA

Brunot Island Power Station



- **Current substation**
- **Close proximity to ALCOSAN wastewater treatment center and commercial districts**
- **Possible site for biogas and waste-to-energy plant**

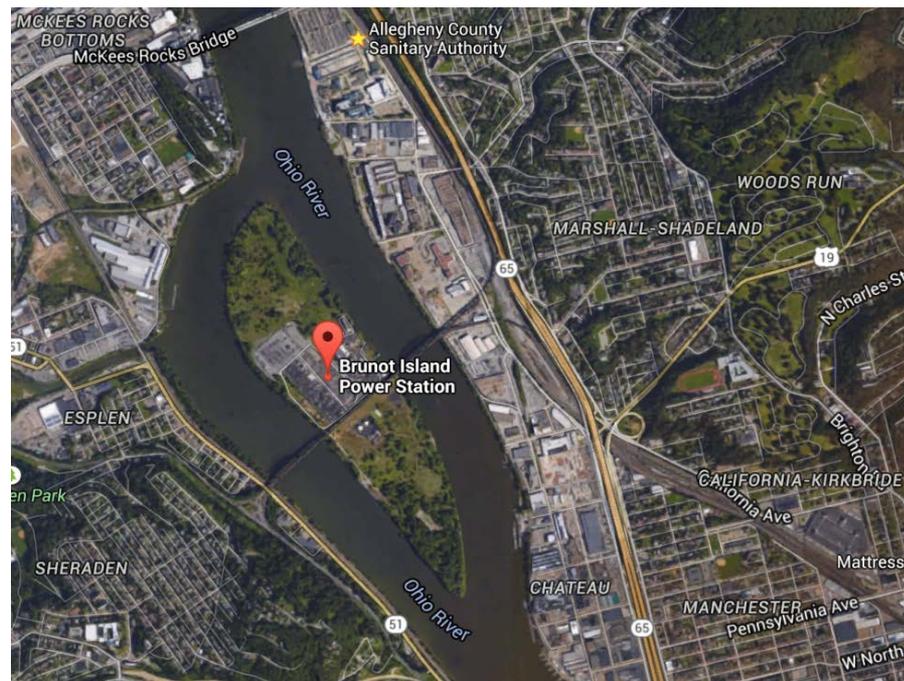
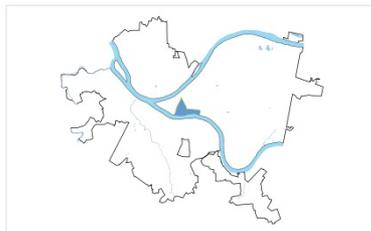


Image Source: Google Maps

Duquesne University Cogeneration Plant



- Began operations in 1997
- Produces 85% of the electricity used on 50-acre campus
- Produces heat for entire campus
- Paired with cooling system



Image source: David Conti, Trib Total Media