

SUSTAINABLE  
CLEVELAND 2019

# Advanced & Renewable Energy:

Powering Northeast Ohio

# Table of Contents

**02** Welcome

**03** Our Policy

**04** Municipal Aggregation

**05** Sustainable Cleveland

**07** Advanced and Renewable Energy

**11** Biomass \***O U**

**15** Solar \***H O U**

**17** GSHP \***H O**

**19** Wind \***H O U**

**23** Co-Generation \***O U**

**24** Hydropower \***U**

**25** Additional Resources

**30** Photo Montage of Installations

**\*** ENERGY SOURCE IS FOR YOUR  
H=HOME O=ORGANIZATION U=UTILITY

# Welcome

Sustainable Cleveland 2019 is a resource that offers information and actionable tools so you can make smart, sustainable choices at home, at work and in your community. By using our assets, natural resources and human capital to benefit the City of Cleveland, area businesses and the 1.6 million people in this region, we are reshaping Cleveland into a vibrant livable city with thriving businesses and a flourishing natural environment. We all prosper when sustainability's three aspects align: our economy is strong, our environment is healthy and our society is vibrant. Advanced & Renewable Energy, in tandem with energy efficiency, is vital to realizing this vision.

As we celebrate the Year for Advanced & Renewable Energy in 2013 and prepare to implement more and more projects in future years, we have updated this primer to illustrate how advanced and renewable energy continues to work in Northeast Ohio. This primer is not intended as an exhaustive guide of everything happening in the region around advanced & renewable energy, but instead a foundation for developing new ideas, new voices, and new partnerships for the way forward. We never do anything without collaborating and I thank everyone who pitched in, especially the Advanced and Renewable Energy Celebration Committee, as well as Cleveland Public Power, Green Energy Ohio, LEEDCo, Tri-C and EcoWatch for their expertise and support.



Sincerely,

Jenita McGowan

Chief of Sustainability, City of Cleveland

## Our Policy

In June 2008, the City of Cleveland adopted a citywide Advanced Energy Portfolio Standard. The standard ensures that 15% of Cleveland Public Power's energy comes from advanced or renewable sources by 2015, 20% by 2020, and 25% by 2025.

Policy is crucial to promoting the wise use of advanced and renewable energy. Growth is strongest where and when policy-makers have established favorable conditions allowing renewables to compete with subsidized fossil fuel-based energy generation. Expanded access to financing for projects also requires a strong regulatory environment and market structures.

The City actively lobbied for the statewide Alternative Energy Portfolio Standard that was passed in 2008. This law requires electric utilities to obtain at least 25% of their power requirements by 2025 from advanced energy and energy efficiency sources. Half of this requirement must be met by renewable energy. The Renewable Energy Policy Project has estimated that a federal renewable energy portfolio standard mandating a 25% reduction in CO2 by 2025, would create 51,269 wind, solar, geothermal, and biomass manufacturing jobs in Ohio alone.

**See the Additional Resources** - Incentives and Support for Ohioans section for more policies. It's up to us to identify additional smart policies that continue to spur development of advanced and renewable technologies in Northeast Ohio.



## Renewables Mix:

♦ 50% Hydropower

♦ 30% Ohio Wind  
Generation

♦ 20% Out-of State  
Wind Generation

# Cleveland's Community Choice Aggregation

As we continue to celebrate the Year for Advanced & Renewable Energy in 2013, we are excited to announce a significant achievement. Beginning in July 2013, Cleveland Electric Illuminating Company (CEI) customers started receiving both a 21% electricity bill savings AND 100% green energy sources. Aggregating renewable energy is one of the first outcomes in Cleveland's Climate Action Plan and affects approximately 65,000 households and small and medium sized businesses in Cleveland.

The City of Cleveland's community aggregation program provides residential and small commercial CEI customers the opportunity to save money on their electric bills. These savings are made possible through governmental aggregation, a community purchasing program led by the City of Cleveland that leverages group buying power for the purchase of electricity.

This aggregation will support approximately 600,000 megawatts hours (MWh) of renewable energy generation, annually. As a result of this leadership, the World Wildlife Fund (WWF) has awarded the City of Cleveland and its residents the 'Bright Place To Live' award.

# Sustainable Cleveland 2019

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In August 2009, Mayor Frank G. Jackson convened the first Sustainability Summit to bring together hundreds of people interested in applying the principles of sustainability to the design of the local economy. The goal: envision a ten-year initiative to build a thriving green

city on a blue lake by the 50th anniversary of the infamous Cuyahoga River fire. Since 2009, thousands of people and dozens of organizations and businesses have been engaged in a variety of Sustainable Cleveland projects and programs.

## **Cleveland: A City that Endures and Thrives**

Living and growing as a sustainable city will ensure Cleveland's longevity. Sustainable Cleveland is a 10-year initiative that engages everyone to work together to design and develop a thriving and resilient Cleveland that leverages its wealth of assets to build economic, social and environmental well-being for all.

## **A Sustainable Economy**

Sustainability means meeting the needs of the present without compromising the ability of future generations to meet their own needs. A sustainable economy integrates the goals of economic prosperity, environmental health and social vitality. We all prosper when sustainability's three aspects align: our economy is strong, our environment is healthy and our society is vibrant.

## **Get Involved**

Here are a couple ways to be a part of the forward momentum of Sustainable Cleveland. Learn more at [www.SustainableCleveland.org](http://www.SustainableCleveland.org) or visit us at the Sustainable Cleveland Center in Tower City in Downtown Cleveland.

## **Annual Sustainability Summit**

Mayor Jackson hosts an annual Sustainability Summit to report progress to the community and co-create our sustainable future. At each Summit, attendees are asked to provide input and commit to action around specific topic areas in Sustainability. Working groups are comprised of individuals, organizations and businesses working together throughout the year on projects, programs, and policies that are making Cleveland more sustainable.

## **Working Groups**

Every year leading up to 2019, Cleveland will focus on one of the key areas fundamental to a sustainable economy. The Celebration Years are designed to be accessible to all members of the community—households, businesses, neighborhoods, and institutions can all participate. Each celebration point will not start or finish in its designated “year-of” – rather, they will all be on-going, with the focus shifting from year to year. The Year of Advanced and Renewable Energy is 2013.



Renewable energy sources are clean and inexhaustible. Types of renewable energy resources include moving water (hydro, tidal and wave power), thermal gradients in ocean water, biomass, geothermal energy, solar energy and wind energy. Cogeneration (i.e. combined heat & power) and municipal solid waste (MSW) to energy are considered types of advanced energy generation.

## Advanced and Renewable Energy

**Advanced and Renewable Energy Works in Northeast Ohio.** Energy use and production is one of the largest sources of carbon emissions in the U.S., as well as one of the most costly expenses for businesses and households. Ohio's extremely high carbon footprint – the fourth highest in the country – is due to its history of heavy manufacturing and high level of dependence on regional coal and foreign fossil fuel production. The state currently sends \$1.7 billion each year to other states to purchase coal as an energy input for power plants, largely from Michigan, Iowa and Indiana. Meanwhile, the rising price of oil puts Northeast Ohio in a vulnerable position.

Working on the issue of climate change is largely about working on energy — working to conserve energy, use energy more efficiently, switch to energy sources with lower carbon content, or design products and processes that require less energy. The region's manufacturing base is well suited for the production of wind turbine and solar components, among other energy devices. National studies have found that Ohio is one of the states best positioned to gain “green” jobs from the growth of energy efficiency and renewable power. Importantly, money spent on renewable energy installation tends to remain in the community, creating jobs and fueling local economics.



About half of the greenhouse gas emissions in Northeast Ohio come from the production and use of electricity. Significantly reducing these emissions will require a major transition in the way we use and generate electricity, such as

- Reduce demand for electricity by promoting efficiency and conservation.
- Change regulatory policies so utilities have a greater incentive to promote conservation than sell more electricity.
- Develop storage capacity (e.g., with compressed air, pumped water, fuel cells) to smooth out power supply.
- Change the mix of power sources, shifting to more efficient generation and cleaner fuel sources.
- Develop efficient plants to produce combined heat and power close to consumers to reduce transmission losses.
- Build a smart power grid to take advantage of intermittent, distributed sources of power.
- Reduce electricity consumption in buildings through high-performance, green design.
- Tie electric vehicles into the grid to create a mass network of storage devices.
- Retire aging coal-fired power plants at the end of their useful lives.
- Make the electric grid more like the Internet—capable of connecting and managing many sources of energy.
- Rapidly phase in wind, solar, and other clean power sources.
- Support stronger standards for appliance and lighting efficiency, and offer incentives to encourage rapid adoption of efficient technologies in homes and businesses.

## **Renewables for your home and business**

Most places in Northeast Ohio have enough renewable energy sources to meet some or all of their needs with one or more renewable energy systems. You can get more specific information by contacting an Ohio renewable energy designer, installer, architect or builder to discuss your power requirements, particulars of your property, what type of systems would suit your needs, resource availability, etc. Visit [www.greenenergyohio.org](http://www.greenenergyohio.org) and see the Additional Resources section for more information.

## **The cost and savings of renewable energy systems**

Your savings will be specific to your circumstances. Depending on the availability of renewable energy resources in your area, some Ohio incentives may help make the economics of installing renewable energy systems more attractive. Solar water heating is cost-effective nearly anywhere compared with heating water with electricity. If you're building now, a carefully thought out energy efficient and passive solar design will cost little extra to build and will pay large dividends in energy cost savings over the life of the building. There are also many inexpensive strategies that can save energy and money in renovated buildings. Like any other major purchase, you have to weigh all the costs and benefits. Renewable energy systems offer many benefits unrelated to cost (clean, low environmental impact, energy independence, etc.) and thus many people choose them even if they are more expensive up front.

### **GRAPH SOURCES:**

#### **US PRIMARY ENERGY**

U.S. Energy Information Administration /  
Annual Energy Review 2010 [www.eia.gov](http://www.eia.gov)

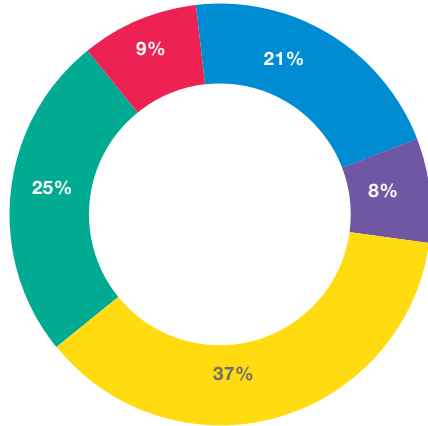
#### **GLOBAL PRIMARY ENERGY**

IPCC, 2011: IPCC Special Report on  
Renewable Energy Sources and Climate Change  
Mitigation. <http://srren.ipcc-wg3.de/>

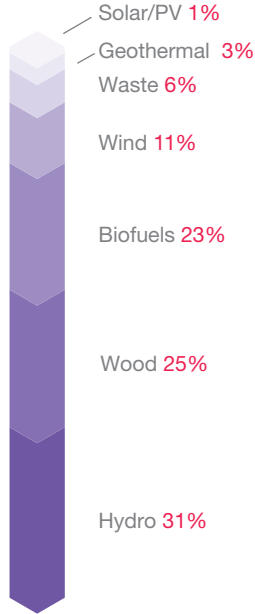
#### **RENEWABLE ENERGY IN NE OHIO**

PUCO, Ohio. <http://www.puco.ohio.gov/puco/>

## U.S. PRIMARY ENERGY SOURCES

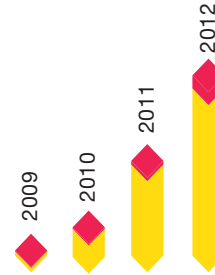


- Nuclear Power
- Coal
- Natural Gas
- Petroleum
- Renewable Energy



## RENEWABLE ENERGY IN NE OHIO

NE OHIO HAS HIGH GROWTH POTENTIAL FOR A MORE SUSTAINABLE ENERGY SYSTEM

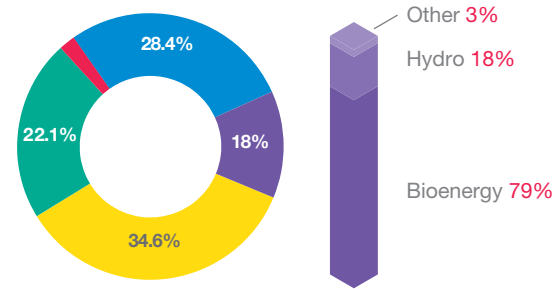


- Megawatts Generated
- Renewable Energy Facilities

2009: 6 Facilities  
2012: 232 Facilities

Cumulative Capacity: 0.2 MW  
Cumulative Capacity: 18.0 MW

## GLOBAL PRIMARY ENERGY SOURCES



# Biomass

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Biopower, or biomass power, is the use of biomass to generate electricity. Biopower system technologies include direct-firing, cofiring, gasification, pyrolysis, and anaerobic digestion. Biomass is biological material that can be used as a renewable energy source. Biomass can be used

for fuels, power production, and products that would otherwise be made from fossil fuels. In such scenarios, biomass can provide an array of benefits.

## Biomass Facts

The use of biomass energy has the potential to greatly reduce greenhouse gas emissions. Burning biomass releases about the same amount of carbon dioxide as burning fossil fuels. However, fossil fuels release carbon dioxide captured by photosynthesis millions of years ago—an essentially “new” greenhouse gas. Biomass, on the other hand, releases carbon dioxide that is largely balanced by the carbon dioxide captured in its own growth (depending how much energy was used to grow, harvest, and process the fuel). However, recent studies have found that clearing forests to grow biomass results in a carbon penalty that takes decades to recoup, so it is best if biomass is grown on previously cleared land, such as under-utilized farm land.

The use of biomass can reduce dependence on foreign oil because biofuels are the only renewable liquid transportation fuels available. Biomass energy supports U.S. agricultural and forest-product industries. The main biomass feedstocks for power are paper mill residue, lumber mill scrap, and municipal waste. For biomass fuels, the most common feedstocks used today are corn grain (for ethanol) and soybeans (for biodiesel). Long-term plans include growing and using dedicated energy crops, such as fast-growing trees and grasses, and algae. These feedstocks can grow sustainably on land.



**Ohio** has biomass energy

with a potential equivalent of

**85 billion KWh/yr  
of electricity**

from crop residue, wood  
manufacturing residues, municipal  
solid waste (MSW) and livestock  
manure.




**quasar** : The Collinwood BioEnergy plant is capable of producing up to 1.3 MW  
: of electricity per hour, which can power up to 800 homes.  
:

## Local Snapshot

There are currently more than 60 businesses and research institutions in Ohio that are involved in the biomass industry.

The Collinwood BioEnergy facility is an anaerobic digestion plant located on Cleveland's east side. This facility applies proven, advanced anaerobic digestion technology to produce electricity from organic waste (biomass). Cleveland Public Power is currently purchasing power from this facility, which is capable of producing 1.3MW of electricity per hour, enough to power more than 800 homes. Collinwood BioEnergy is of special significance to Cleveland as it was constructed on the grounds of the former Collinwood GM Fisher Body Plant. Collinwood BioEnergy represents a partnership between Quasar Energy and Forest City, and was made possible through funds from the City of Cleveland's Department of Economic Development, the State of Ohio, and the American Recovery and Reinvestment Act. Please visit [www.quasarenergypgroup.com](http://www.quasarenergypgroup.com) for more information.

Another project of regional interest is in Akron, Ohio in partnership with the City of Akron's wastewater treatment plant and KB Composting near the Cuyahoga Valley National Park. This facility takes the by-product of the wastewater treatment plant and utilizes the "sludge" to generate electricity at the facility. More information on this project can be found at [www.kbcompost.com](http://www.kbcompost.com).



According to the Public Utilities Commission of Ohio, economic activity associated with biomass currently supports about 66,000 mostly rural jobs in the U.S., with great opportunity for growth.

According to a study by The Ohio State University, Ohio can support 6,447 anaerobic digestion waste-to-energy facilities representing \$15.3 Billion in investment.

# Solar Energy

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Energy from the sun has been harnessed for thousands of years. Today, residents and businesses can use this energy in three main ways to produce renewable solar energy:

## Photovoltaic

Photovoltaics (PV) consist of weather-protected panels (also called modules), fastened side-by-side on a racking system to form an array. The PV modules produce direct current (DC), which flows to an inverter. The inverter changes DC voltage to alternating current (AC) for the household electric circuit.

Excess power from the inverter may flow out of the house or business through the utility company's electric meter, into the city-wide grid. The utility credits the out-flowing electricity against electricity purchased from the grid at night. This process is called net-metering. In off-grid residential systems, common in remote locations, the use of storage batteries is more common because excess power is not sold back into the grid.

Most home systems today use silicon PV modules because they produce the most power in the limited space available on a house roof. Cheaper thin-film modules are more common in larger industrial arrays. The opportunity for PV in Northeast Ohio goes beyond installations, into manufacturing. At the beginning of 2011, Ohio ranked second nationally in solar panel production.





**StarGen™** : Solar Photovoltaic Concentrator System at the Rockefeller Park  
Greenhouse in Cleveland, Ohio.

## Solar Hot Water and Space Heating and Cooling

Solar hot water heaters use the sun to heat either water or a heat-transfer fluid in collectors. A typical home system will reduce the need for conventional water heating by about two-thirds. High-temperature solar water heaters can provide energy-efficient hot water and hot water heat for commercial and industrial facilities.

In most parts of North America, the best bang for your solar energy buck is with domestic solar water heating (DSWH). Factoring in the 30 percent federal tax credit, a DSWH system for your home can be installed for \$3,000 to \$5,000, depending on its size, complexity and location. At today's energy prices, over the life of the system, the cost to operate is about 20 to 40 percent lower than conventional stand-alone gas or electric water heaters, respectively. According to the U.S. Department of Energy, DSWH pays for itself in savings when factored into a mortgage for new construction — from day one.

Energysavers.gov provides a good guide to determine what configuration best fits your needs.

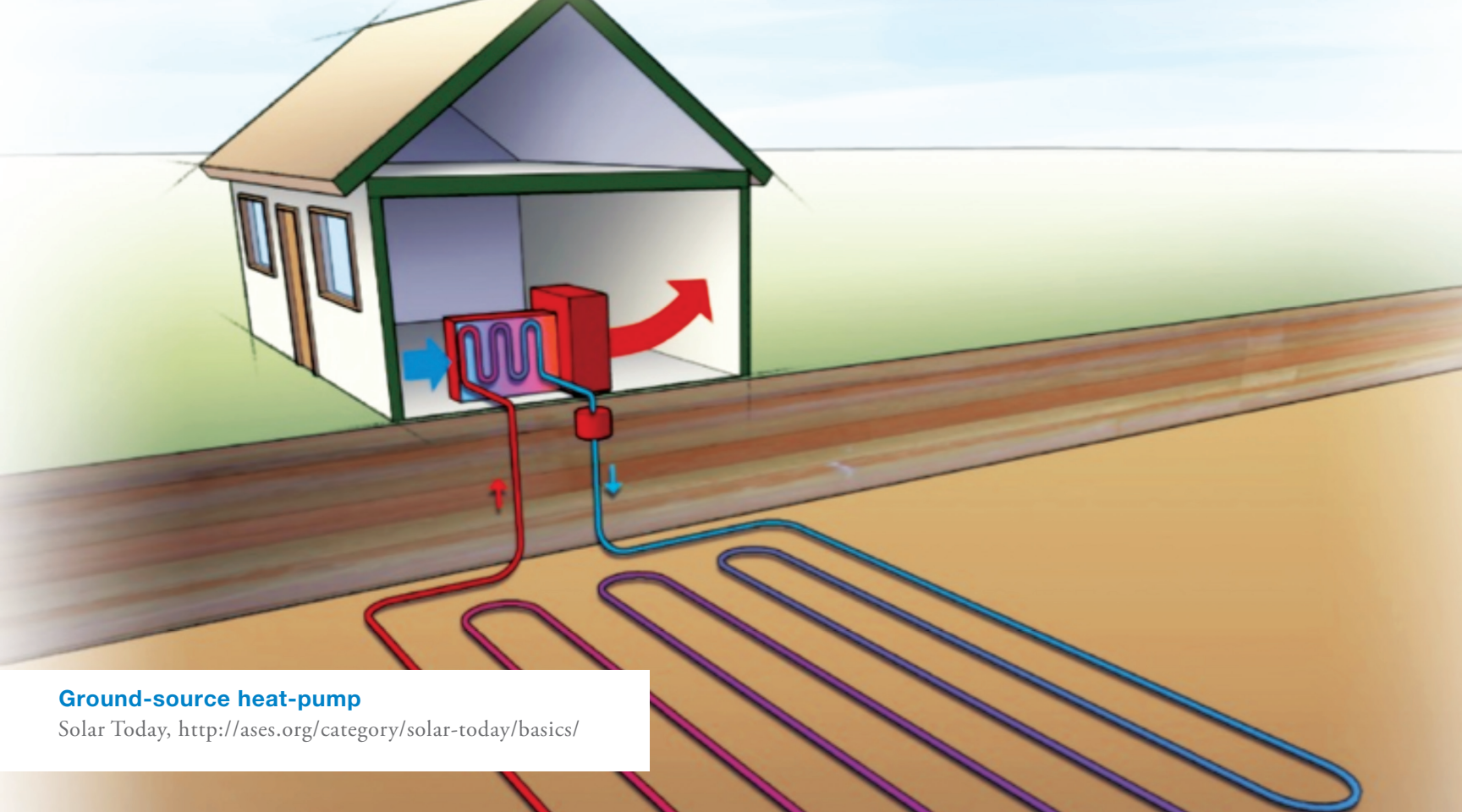
## Passive Solar Heating, Cooling and Daylighting

Buildings designed for passive solar and daylighting incorporate design features such as large south-facing windows and building materials that absorb and slowly release the sun's heat. No mechanical means are employed in passive solar heating. Incorporating passive solar designs can reduce heating bills as much as 50 percent. Passive solar designs can also include natural ventilation for cooling. Visit [greenenergyohio.org](http://greenenergyohio.org) for much more information about installing solar energy in your home or business.

## Ground-source heat-pump

Ground-source heat-pump (GSHP) heating and cooling, often called a geo-exchange or geothermal system, is an efficient way to keep a house comfortable. A GSHP uses a network of buried tubing, heat-exchange fluid and a compressor to work off of the stable temperature of the soil or groundwater under your property. In most parts of the country that's about 55°F (12°C). It uses the earth as a heat source (in the winter) or a heat sink (in the summer). An electric pump sends fluid through the loop field, transferring heat from the loop field to inside the house.

A small house typically requires about 10.5 kilowatts of heating/cooling capacity. A GSHP system for a small house would cost roughly \$7,500. Typically, a GSHP system can provide a payback of about five years.



### Ground-source heat-pump

Solar Today, <http://ases.org/category/solar-today/basics/>

# Wind Power

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Wind energy technologies use the energy in wind for practical purposes such as generating electricity, charging batteries, and pumping water. Most wind energy technologies can be used as stand-alone applications, connected to a utility power grid, or even combined with a photovoltaic system. For utility-scale sources of wind energy, a large number of turbines are usually

built close together to form a wind farm that provides grid power. Several electricity providers use wind farms to supply power to their customers. Stand-alone turbines are typically used for water pumping or communications. However, homeowners and farmers in windy areas can also use small wind systems to generate electricity.

## Onshore Wind

Northeast Ohio is no stranger to the concept of wind energy. In 1887, the world's first electricity generating wind turbine was invented at E. 37th St in Cleveland, Ohio. Outside of his home on Millionaire's Row, inventor Charles F. Brush installed a 144-blade machine with a 50-foot rotor. This dynamo lasted more than 20 years and while it only had the capacity of 12 kilowatts (kW), he became the first Clevelander to have electricity in his home.

A century later, Northeast Ohio witnessed a wind energy resurgence with NASA Glenn's (Lewis) wind energy program, which gained international acclaim in 1981 with a 3.2 megawatt (MW) turbine, a world record until 2005.

As prices for wind have continued to go down, a number of onshore turbines have begun to sprout up around the region. Examples include the Great Lakes Science Center (225 kW), Lincoln Electric (2.5 MW), Case Western Reserve University (100 kW, 225 kW, and 1 MW), and the Cuyahoga County Fairground (500 kW).

As a region, to reap the substantial economic benefits from wind, we not only need to scale up the number of onshore installations, it's imperative to develop an offshore wind industry.

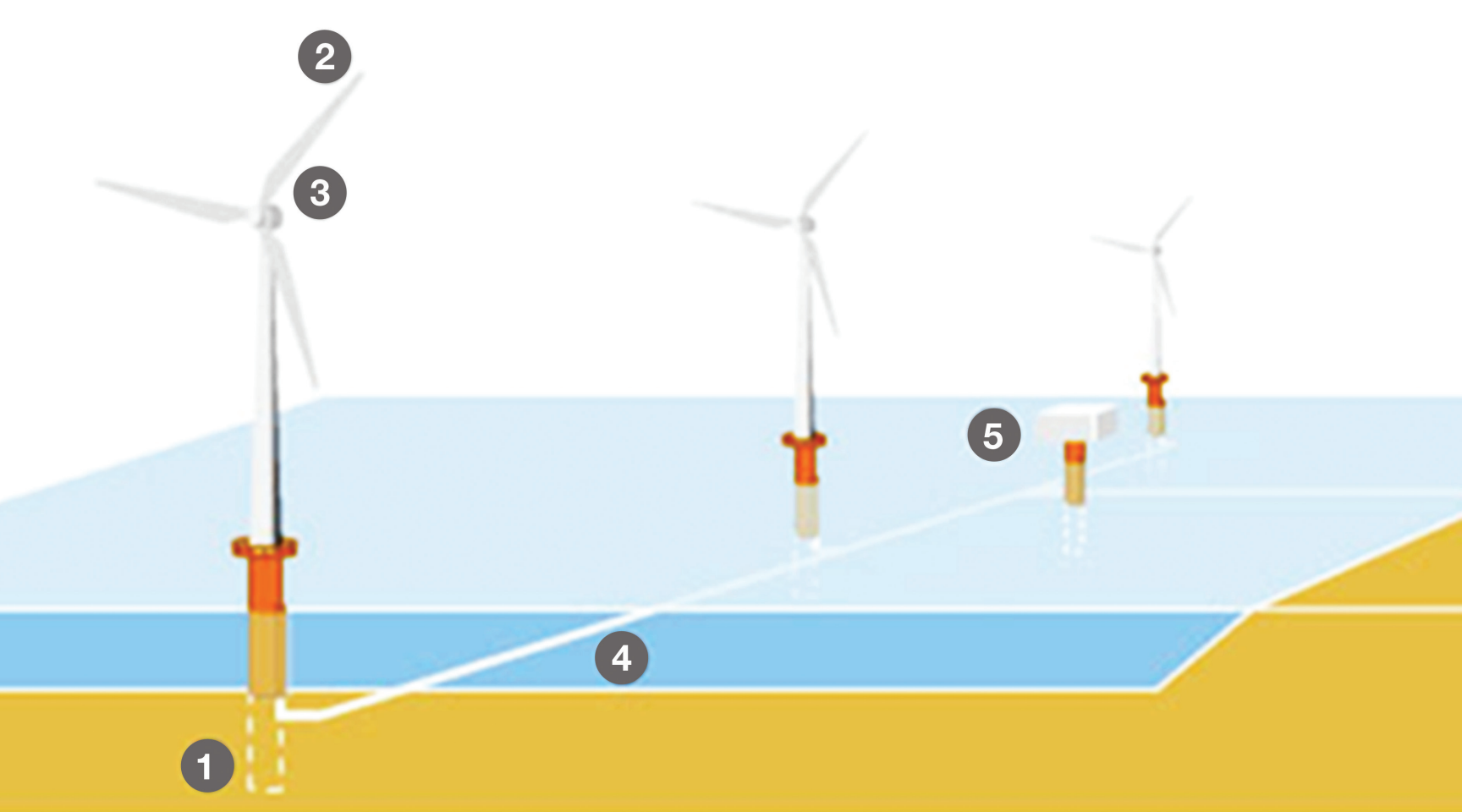
## Offshore Wind

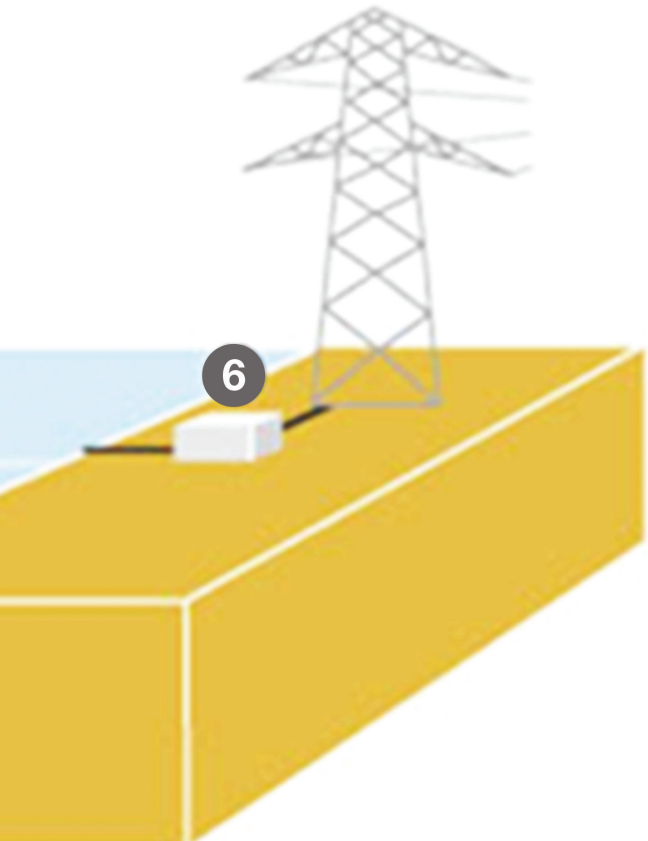
Wind energy exploration in Northeast Ohio was rekindled again in 2004 with the idea of building a regional offshore wind industry in Lake Erie as a means of economic development. Green Energy Ohio partnered with the City of Cleveland and Case Western Reserve University, among others, to install a wind measuring device (called an anemometer) to understand the potential. To say the least, the potential is great.

Since 2009, the Lake Erie Energy Development Corporation (LEEDCo) has been leading the community's efforts, including a Power Pledge campaign in 2013, to build and install an initial offshore wind pilot project near Cleveland in Lake Erie. This 18 megawatt pilot wind farm project 7 miles offshore, would be the first freshwater offshore wind farm in North America and a first step toward the eventual installation of 1,000 MW of wind capacity in the Ohio waters of Lake Erie.

Already the recipient of more than \$4 million in U. S. Department of Energy (DOE) grants, LEEDCo is competing for nearly \$50 million in additional grants in 2014. Importantly, Cleveland Public Power has already committed to purchase 5 MW of energy from this pilot project.







## How does an offshore wind farm work?

**Piles (1)** are driven into the seabed once a suitable place for the wind farm is found. Erosion protection is placed at the base to prevent damage to the sea floor. The top of the foundation is painted a bright color to make it visible to ships and has an access platform to allow maintenance teams to dock.

Once the turbine is assembled, sensors on the turbine detect the wind direction and turn the head, known as the nacelle, to face into the wind, so that the blades can collect the maximum amount of energy. The movement of the wind over the aerodynamically shaped **blades (2)** makes them rotate around a horizontal hub, which is connected to a shaft inside the **nacelle (3)**. This shaft, via a gearbox, powers a generator to convert the energy into electricity. **Subsea cables (4)** take the power to an **offshore transformer**

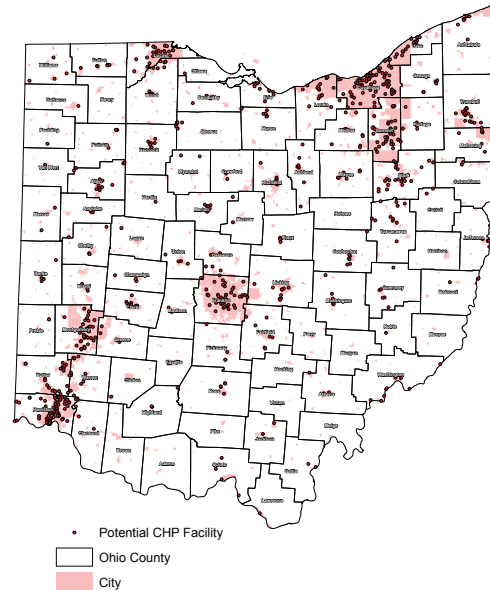
**(5)** which converts the electricity to high voltage (33kV) before connecting to the grid at a **substation on land (6)**.

Source: Renewable UK, <http://www.bwea.com/offshore/how.html>

# Co-Generation

Co-generation, also known as “combined heat and power,” is the simultaneous production of heat and electricity from a single fuel source. Considered highly efficient, co-generation captures heat lost during the production of electricity and converts it into useful thermal energy, usually in the form of steam or hot water. While the traditional method of separately producing usable heat and power has a typical combined efficiency of 45%, CHP systems can operate at efficiency levels as high as 80%.

Potential Combined Heat and Power Facilities



Potential CHP MAP

Map Source: [www.puco.ohio.gov](http://www.puco.ohio.gov)



# Hydropower

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Hydropower, or electricity produced from moving water, it is considered renewable due to inexhaustible nature of the water cycle. As flowing water moves downstream, it is directed into a turbine that drives the generator and produces electricity.

## Hydro Overview

Hydropower does not produce solid, liquid, or gaseous pollutants, but it can pose risks to native species, local lifestyles, and landscape if not done properly. Therefore it's important to pursue low-impact alternatives for new stations. Certification can be achieved through the Low Impact Hydropower Institute.

## CPP Hydro

Cleveland Public Power is currently participating in five hydroelectric projects through its joint action agency, American Municipal Power. All five are low-impact hydro projects located at existing locks and dams on the Ohio River. Four of the projects are under construction: Cannelton, Smithland, Willow Island and Meldhal and are scheduled to begin operation in the 2014-2015 time frame. The fifth plant, an existing hydro project at the Greenup Dam, will be pooled with the other four to produce a total of over 350 megawatts for the five plants. CPP has committed to receive up to 50 megawatts of the total which will enable CPP to meet the Advanced Energy Portfolio Standards adopted by the City Administration several years ago.

# Additional Resources

## **American Solar Energy Society**

National organization dedicated to advancing the use of solar energy for the benefit of U.S. citizens and the global environment. [www.ases.org](http://www.ases.org)

## **American Wind Energy Association**

National organization dedicated to promoting wind power growth through advocacy, communication and education. [www.awea.org](http://www.awea.org)

## **Better Buildings Challenge**

A White House and U.S. Department of Energy initiative to support building owners by providing technical assistance and proven solutions to energy efficiency. Partners include the City of Cleveland, Cleveland Clinic, and Forest City Enterprises. [www4.eere.energy.gov/challenge/](http://www4.eere.energy.gov/challenge/)

## **Case Western Reserve University's Great Lakes Energy Institute**

Connecting faculty to create breakthrough research and technologies to transition into worldwide impact. [energy.case.edu/](http://energy.case.edu/)

## **Cleveland 2030 District**

The district is a coalition of building owners, service professionals and community stakeholders working together to rapidly transform the built environment

of the city through large-scale reductions in energy use, water use and GHG emissions. [www.2030district.org/cleveland/](http://www.2030district.org/cleveland/)

## **Earth Day Coalition**

Aligns the theme of their annual EarthFest with the Celebration Year of Sustainable Cleveland 2019. The Clean Transportation Program also educates consumers and fleets about clean fuels, practices, and technologies that help Northeast Ohio reduce its dependency on foreign oil. [www.earthdaycoalition.org/](http://www.earthdaycoalition.org/)

## **Green Energy Ohio (GEO)**

Statewide nonprofit organization dedicated to promoting economically and environmentally sustainable policies and practices in Ohio, serving as the Ohio chapter of the American Solar Energy Society. Sign-up for annual renewable energy tours online. [www.GreenEnergyOhio.org](http://www.GreenEnergyOhio.org)

## **Great Lakes Energy Development Task Force**

This task force explores options for advanced and renewable energy in Northeast Ohio. In 2009, the Task Force created the Lake Erie Energy Development Corporation (LEEDCo). [development.cuyahogacounty.us/en-US/energy-task-force.aspx](http://development.cuyahogacounty.us/en-US/energy-task-force.aspx)

## **Great Lakes Wind Network**

Supply-chain development advisory group and network of manufacturers who work to increase the domestic content of North America's wind turbines. [www.glwn.org/](http://www.glwn.org/)

## **GreenCityBlueLake Institute**

GCBL is making the Cleveland Museum of Natural History a hub of sustainability information and activity — a place where the public comes to create new visions of a sustainable future. [www.gcbl.org/](http://www.gcbl.org/)

## **Lake Erie Energy Development Corporation (LEEDCo)**

Regional non-profit and economic development organization building an offshore wind energy industry in Ohio. <http://www.leedco.org/>

## **Low Impact Hydropower Institute**

Nonprofit organization dedicated to reducing the impacts of hydropower generation through the certification of environmentally responsible, "low impact" hydropower. [www.lowimpacthydro.org](http://www.lowimpacthydro.org)

## **NASA Green Lab**

Completed in November 2009, the Green Lab Research Facility is experimenting with salt-water algae and halophytes as bio-fuels of the future.

Call (216) 433-9653 to register for a one-hour tour. [www.nasa.gov/centers/glenn/events/tour\\_green\\_lab.html](http://www.nasa.gov/centers/glenn/events/tour_green_lab.html)

### **National Renewable Energy Laboratory**

The Department of Energy's laboratory for renewable energy and energy efficiency research and development. [www.nrel.gov](http://www.nrel.gov)

### **NorTech Energy Enterprise**

NorTech Energy Enterprise is accelerating the growth of the advanced energy cluster in Northeast Ohio to create jobs and attract capital to the region. [www.nortech.org/energy](http://www.nortech.org/energy)

### **North American Board of Certified Energy Practitioners**

Operates nationally recognized credentialing programs for installers of renewable energy technology. [www.nabcep.org](http://www.nabcep.org)

### **Northeast Ohio Advanced Energy District**

Ohio's first energy special improvement district, a not-for-profit entity, created by the City of Cleveland and the municipalities of the First Suburbs Development Council. <http://www.neoaed.org/>

### **Northeast Ohio Chapter of the U.S. Green Building Council**

The USGBC's community of leaders is working to make green, healthy buildings available to everyone within a generation. [www.neogbc.org/](http://www.neogbc.org/)

### **Ohio Biomass Energy Program**

Part of the Great Lakes Regional Biomass Program and focused on increasing the development and utilization of biomass energy resources in Ohio. Contact PUCO's Anne Goodge, Program Director, at (614) 644-7857

### **Ohio Farm Bureau Federation**

Ohio's largest general farm organization with 225,000 member families located in all rural, suburban and urban areas of the state. Contact Dale Arnold, Director of Energy Services, at [darnold@ofbf.org](mailto:darnold@ofbf.org)

### **Ohio Energy Resources Division**

State government agency working towards a robust economy supported by multiple energy sources, energy efficiency and advanced technology. [www.development.ohio.gov/energy](http://www.development.ohio.gov/energy)

### **Ohio Energy Project**

Nonprofit organization dedicated to promoting an energy-educated society and facilitating effective partnerships with schools, businesses, governments and communities. [www.ohioenergy.org](http://www.ohioenergy.org)

### **Solar Energy Industries Association**

National trade association of solar energy manufacturers, dealers, distributors, contractors, installers, architects, consultants and marketers. [www.seia.org](http://www.seia.org)

### **University Clean Energy Alliance of Ohio**

Statewide organization supporting clean energy research, strengthening education, promoting a strong and vibrant business community, and enhancing Ohio's advanced energy economy. [www.uceo.org/](http://www.uceo.org/)

### **U.S. Department of Energy**

Provides free general and technical information to the public on the many topics and technologies pertaining to energy efficiency and renewable energy. [www.eere.energy.gov](http://www.eere.energy.gov)

### **Renewable Energy Installers, Contractors And Distributors In Ohio**

Visit the Green Energy Ohio website for a directory of professionals working in Ohio.  
[www.GreenEnergyOhio.org](http://www.GreenEnergyOhio.org)

### **UTILITY CONTACTS**

Necessary to contact when connecting to utility grid (net metering) with a renewable energy project.

#### **Cleveland Public Power**

1300 Lakeside Avenue  
Cleveland, Ohio 44114  
[www.cpp.org](http://www.cpp.org)

#### **First Energy**

Bruce Rommel  
PO Box 16001  
2800 Pottsville Pike  
Reading, PA 19612  
610) 921-6839

#### **Consumers' Counsel And Public Utility Commission**

Ohio Consumers' Counsel  
Ohio's residential utility consumer advocate. [www.pickocc.org](http://www.pickocc.org)

#### **Public Utility Commission of Ohio (PUCO)**

Government agency that regulates providers of

utility serves, including electric and natural gas companies. [www.puc.state.oh.us](http://www.puc.state.oh.us)

### **INCENTIVES AND SUPPORT FOR OHIOANS**

Advanced Energy Program  
Grants for commercial, industrial, and residential projects are available through the Ohio Energy Resources Division. [development.ohio.gov/energy/incentives/grantsloans.Htm](http://development.ohio.gov/energy/incentives/grantsloans.Htm)

#### **Conversion Facilities Tax Exemption**

The State of Ohio provides tax exemptions for qualified facilities for energy conversion, solid waste energy conversion or thermal efficiency improvements. [development.ohio.gov/](http://development.ohio.gov/)

#### **Federal Tax Credits**

For more information on these credits, visit [www.dsireusa.org](http://www.dsireusa.org)

##### **Residential**

Allowable tax credit is 30% of the installed cost of a qualified solar electric, solar thermal, wind, geothermal, or fuel cell system.

##### **Business**

Allowable tax credit is 30% of the installed cost of a qualified solar electric, solar thermal, wind, or fuel cell system, and 10% for geothermal, microturbines, or CHP systems.

### **Net Metering/Simplified Interconnection**

If your system is connected to the grid in an investor-owned utility (AEP, First Energy, etc), then the utility is required to net meter any excess electricity produced from your renewable energy system (yes – the electric meter spins backwards!) [www.puco.ohio.gov/puco/index.cfm/information-by-industry/electric-consumer-information/](http://www.puco.ohio.gov/puco/index.cfm/information-by-industry/electric-consumer-information/)

#### **Ohio Air Quality Development Authority (OAQDA)**

The OAQDA can offer tax exemptions (sales and use tax, and corporate franchise tax) for renewable energy projects. While the majority of the projects come from business and institutional customers, residential applications are eligible and cost effective if the project is of substantial size. [www.ohioairquality.org](http://www.ohioairquality.org)

#### **Wind Energy Regulations**

In 2009, The City updated the zoning code regulations to ensure that wind energy facilities are developed and maintained to maximize utilization of Cleveland's wind energy resources while protecting public health, safety and welfare. [planning.city.cleveland.oh.us/zoning/pdf/354a01windEnergy.pdf](http://planning.city.cleveland.oh.us/zoning/pdf/354a01windEnergy.pdf)

## ONLINE TOOLS AND RESOURCES

### NREL In My Backyard Tool

The In My Backyard (IMBY) tool estimates the electricity you can produce with a solar photovoltaic (PV) array or wind turbine at your home or business. Find the IMBY tool here: [mercator.nrel.gov/imby/](http://mercator.nrel.gov/imby/) or <http://pwattsbeta.nrel.gov> (new PWWatts Site)

### Ohio Wind Resource Map

An interactive web site that displays maps of mean annual wind speed at 30, 50, 70, and 100 meters, and maps of wind power density at 50 and 100 meters. Find out what the wind resource is on your property. [maps.opsb.ohio.gov/windmap/welcome.htm](http://maps.opsb.ohio.gov/windmap/welcome.htm)

### Virtual Ohio Solar Tour

An interactive website that uses Google Maps to pinpoint over 200 clean energy installations by technology, type and location. [www.GreenEnergyOhio.org/ost](http://www.GreenEnergyOhio.org/ost)

## RENEWABLE ENERGY JOB RESOURCES

American Solar Energy Society: [www.ases.org](http://www.ases.org)

American Wind Energy Association: [www.awea.org](http://www.awea.org)

Department Of Energy Solar Career Map: [www1.eere.energy.gov/solar/careermap/](http://www1.eere.energy.gov/solar/careermap/)

Environmental Career Center: [www.environmentalcareer.com](http://www.environmentalcareer.com)

Environmental Career Opportunities: [www.ecojobs.com](http://www.ecojobs.com)

Environmental Careers Organization: [www.eco.org](http://www.eco.org)

Green Energy Jobs: [www.greenenergyjobs.com](http://www.greenenergyjobs.com)

Green Jobs: [www.greenjobs.com](http://www.greenjobs.com)

Idealist: [www.idealists.org/](http://www.idealists.org/)

National Renewable Energy Lab: [www.nrel.gov/employment](http://www.nrel.gov/employment)

Renewable Energy Access: [www.renewableenergyaccess.com/rea/jobs/home](http://www.renewableenergyaccess.com/rea/jobs/home)

Sustainable Business: [www.sustainablebusiness.com/jobs](http://www.sustainablebusiness.com/jobs)

## PERIODICALS, MAGAZINES, & ONLINE SOURCES

EcoWatch: <http://ecowatch.org/p/energy/renewable-energy-energy/>

Natural Resources Defense Council - Ohio: [www.nrdc.org/energy/renewables/ohio.asp](http://www.nrdc.org/energy/renewables/ohio.asp)

REFocus: [www.re-focus.net](http://www.re-focus.net)

Renewable Energy E-Newsletter: [www.renewableenergyaccess.com](http://www.renewableenergyaccess.com)

Renewable Energy World: [www.renewable-energy-world.com](http://www.renewable-energy-world.com)

Solar Buzz Newsletter: [www.solarbuzz.com](http://www.solarbuzz.com)

Solar Today: [www.solartoday.org](http://www.solartoday.org)



10 KW ground mounted solar system powering 100% of the family of Tom and Diane Jones' electricity needs in Auburn Township.

Image Courtesy: Bold Alternatives/Expedite Renewable Energy



Ground Source Heat Pumps (geothermal wells) are used to heat and cool the museum by geothermal wells located under the adjacent plaza.

Image Courtesy: MOCA Cleveland





Onshore wind turbine w/ peak output of 225KW at wind speeds of 31 mph.  
Solar array canopy producing an annual average of 100KWh/day at the Great Lakes Science Center, Cleveland.

Image Courtesy: Great Lakes Science Center, Cleveland



Northeast Ohio Regional Sewer District (NEORSD) Southerly Wastewater Treatment Plant - Renewable Energy Facility designed to cut natural gas consumption by 95% and power 25% of the plant's electricity.

Image Courtesy: NEORSD



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