



Advanced Energy Topics for Hill District Community Leaders

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National Renewable Energy Laboratory (NREL)

August 2024

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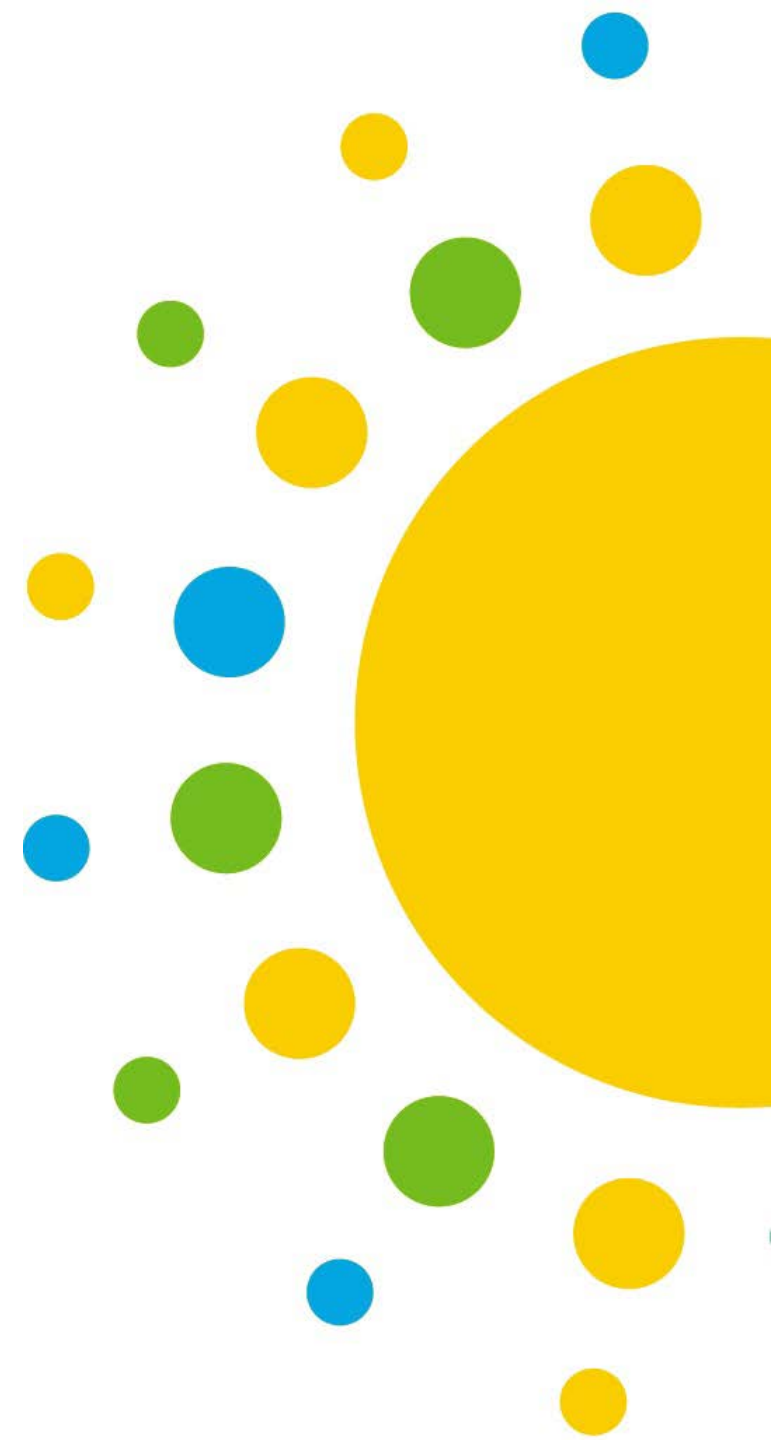
This work was authored by the National Renewable Energy Laboratory (NREL), operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08G028308. Funding provided by the DOE's Communities LEAP (Local Energy Action Program) Pilot.

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Communities LEAP Pilot Technical Assistance Opportunity



The Communities Local Energy Action Program (LEAP) Pilot Competitive Technical Assistance opportunity aims to facilitate sustained, community-wide economic empowerment through clean energy, improve local environmental conditions, and open the way for other benefits, primarily through the U.S. Department of Energy's clean energy deployment work.

This opportunity was open to low-income, energy-burdened communities also experiencing either direct environmental justice impacts or direct economic impacts from a shift away from historical reliance on fossil fuels.

Hill District Communities LEAP Overview

Through Communities LEAP, a community coalition focused on the Hill District neighborhood of Pittsburgh is working with a technical assistance provider network led by the National Renewable Energy Laboratory (NREL). The coalition includes community organizations, nonprofits, the city government, and the utility.

Technical assistance provides analysis and information to support Hill District stakeholders in their goals to create informed residential energy efficiency and renewable energy transition strategies that:

- Improve housing conditions and lower energy bills
- Incorporate energy efficiency and renewable energy strategies into existing, community-driven development efforts
- Generate quality local jobs.

Introduction and Purpose

- The *Advanced Energy Topics* resource is intended to support Hill District community leaders with strategic planning on energy-related topics.
- The topics included are intended to serve as a technical reference for community leaders to help inform decision-making around energy.
- Links are provided to additional resources for those who wish to dive deeper into the topics introduced in this resource.
- The *Advanced Energy Topics* resource was informed by engagement through the Communities LEAP pilot program with three Hill District Registered Community Organizations: the Hill District Collaborative, the Hill District Consensus Group, and the Hill Community Development Corporation.

Note: The Advanced Energy Topics resource is not intended to be exhaustive and is meant to be appropriate for those with varying levels of expertise in the topic areas presented.

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Acronyms

AMI: Area Median Income

CELICA: Clean Energy for Low Income Communities Accelerator

LEAP: Local Energy Action Program

LMI: low- and moderate-income

NREL: National Renewable Energy Laboratory

PV: photovoltaic

R2E2: Residential Retrofits for Energy Equity

WAP: Weatherization Assistance Program

Glossary

- **Air leakage/infiltration/exfiltration:** Air leakage occurs when outside air enters and conditioned air leaves a building uncontrollably through cracks and openings (DOE n.d.[a])
- **Air-source heat pump:** An air-source heat pump can provide efficient heating and cooling for a home. When properly installed, an air-source heat pump can deliver up to three times more heat energy to a home than the electrical energy it consumes. This is possible because a heat pump transfers heat rather than converting it from a fuel, like combustion heating systems (DOE n.d.[a]).
- **Community solar:** A solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, nonprofits, and other groups (EERE n.d.[b]).
- **Energy efficiency:** Energy efficiency is using less energy to perform the same task or produce the same result (EERE n.d.[b]).

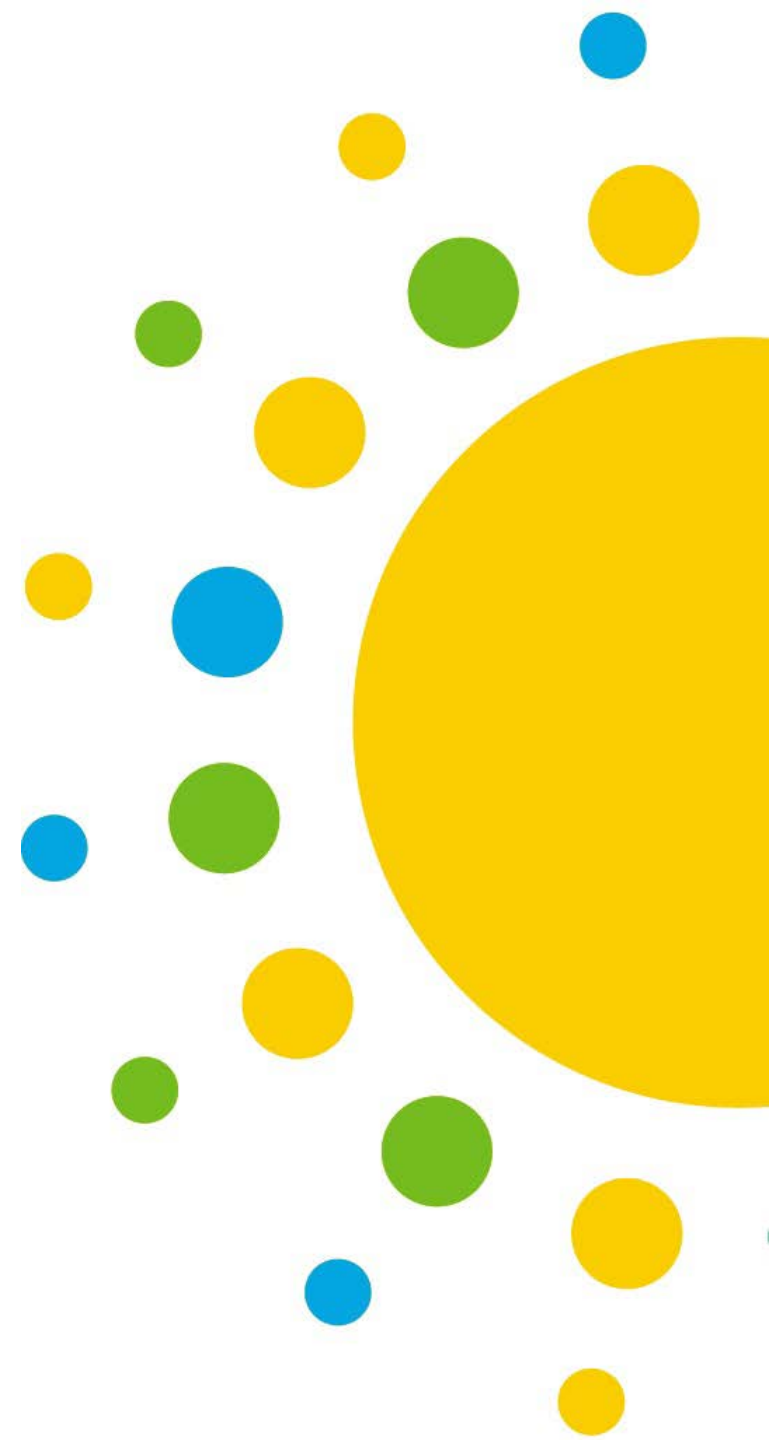
Glossary (cont.)

- **Geothermal heat pump:** Geothermal (ground-source or water-source) heat pumps achieve higher efficiencies by transferring heat between a home and the ground or a nearby water source (Energy.gov n.d.[g]).
- **Heating season performance factor:** The heating season performance factor is a measure over an average heating season of the total heat provided to the conditioned space, expressed in British thermal units (Btu), divided by the total electrical energy consumed by the heat pump system, expressed in watt-hours (Energy.gov n.d.[a]).
- **Insulation:** Insulation provides resistance to heat flow and lowers heating and cooling costs. Properly insulating a home not only reduces heating and cooling costs, but also improves comfort (Energy.gov n.d.).
- **Mini-split heat pump:** Ductless heat pumps, or mini-split heat pumps, are an alternative to radiator or baseboard heating, as well as a replacement for window units for cooling. No duct work is needed. Instead, a head unit, or multiple head units, is mounted on an interior wall or ceiling, with an accompanying unit outside (ENERGY STAR n.d.).

Glossary (cont.)

- **Retrofit:** A retrofit is the addition of new technology or features to an older system.
- **R-value:** An insulating material's resistance to conductive heat flow is measured or rated in terms of its thermal resistance, or R-value. The higher the R-value, the greater the insulating effectiveness (Energy.gov n.d.).
- **Seasonal energy efficiency ratio:** Seasonal energy efficiency ratio is a measure over an average cooling season of the total heat removed from the conditioned space, expressed in Btu, divided by the total electrical energy consumed by the heat pump, expressed in watt-hours (Energy.gov n.d.[a]).
- **Thermal envelope:** The thermal envelope is everything about the house that serves to shield the living space from the outdoors. It includes the wall and roof assemblies, insulation, air/vapor retarders, windows, and weatherstripping and caulking (EERE 2000).
- **Weatherization:** Weatherization refers to improvements to a building to protect the inside from the outside weather and to increase energy efficiency (Energy.gov n.d.[b]).

Solar Energy



Introduction: Solar Energy

- Renewable energy, including solar energy, can yield a wide range of benefits, including:
 - Lower energy costs
 - Enhanced reliability, security, and resilience of the power grid
 - Job creation through the increased production and manufacturing of renewable energy technologies
 - Reduced carbon emissions and air pollution from energy production (EERE n.d.).
- However, there are significant barriers to adoption, including finance and funding, community engagement, site suitability, policy and regulatory challenges, and resilience and recovery considerations (Heeter et al. 2021).

Barriers to Solar Adoption

Barriers	Description
Finance and Funding	<ul style="list-style-type: none"> • Inability to afford an upfront solar payment. • Difficulty accessing low-cost financing options. • Limited low- and moderate-income (LMI)-specific incentives, credits, or financing mechanisms. • LMI incentives that may exclude community-based organizations, Tribal entities, and others. • LMI households may not be able to fully utilize the federal investment tax credit. • Reports of predatory practices by service or resource providers.* • Risks of increased energy bills or debt burdens.
Community Engagement	<ul style="list-style-type: none"> • Lack of trusted, unbiased information on solar in LMI communities. • Low level of trust for solar technologies and developers, paired with contracts and bill crediting schemes that can be time-consuming to understand. • LMI communities have been targeted for scams and exploitation, so they can be distrustful of promises of energy savings. • Limited capacity for LMI households to participate in utility and regulatory processes.

Sources: Heeter et al. (2021); Rosner et al. (2023).

**Identified in listening sessions for LA100 Equity Strategies report. The term “Predatory Practices” was used when a participant referred to service or resource providers who take advantage of local communities.*

Barriers to Solar Adoption

Barriers	Description
Site Suitability	<ul style="list-style-type: none"> Higher proportions of old roofs and roofs in need of repair or replacement before solar can be installed Increased needs for home improvement measures before solar can be installed (e.g., updating electrical wiring or service panels). Lack of authority for LMI households residing in rental homes, apartments, condos.
Policy and Regulatory	<ul style="list-style-type: none"> Absence of enabling legislation for community solar in some states. Solar incentives and policies that can be piecemeal, inconsistent over time, and not well integrated with other programs and incentives, such as energy assistance, home and vehicle electrification efforts, and disaster planning and mitigation. “Soft costs” such as permitting and interconnection delays, especially for LMI households. Absence of adequate consumer protections in place for low-income customers
Resilience and Recovery	<ul style="list-style-type: none"> LMI households face more adverse effects of economic hardship. Inability of LMI households to take advantage of disaster recovery funds at the same rate as higher-income households.

Source: Heeter et al. (2021)

Barriers to Solar Adoption: Additional Resources

- The Yale Center for Business and the Environment examined the barriers facing LMI households in obtaining solar power: [Research Review on Residential Solar Access: Barriers and Solutions for Low and Moderate Income Communities](#).
- NREL found that community solar could be a viable option for overcoming barriers such as constraints caused by roof conditions and property ownership: [Technical Potential and Meaningful Benefits of Community Solar in the United States](#).

Solar Photovoltaic (PV) Energy Basics

- Converts sunlight directly into electricity
- **Solar irradiance:** the power from the sun that reaches a surface per area unit
- Solar PV can work even with:
 - Cloud cover
 - Low irradiance (*see lighter yellow on map to the right*).
- Snow cover can impact PV generation performance. Researchers at Sandia National Laboratories cites potential losses ranging from 1% to 15% annually (Sandia National Laboratories n.d.).

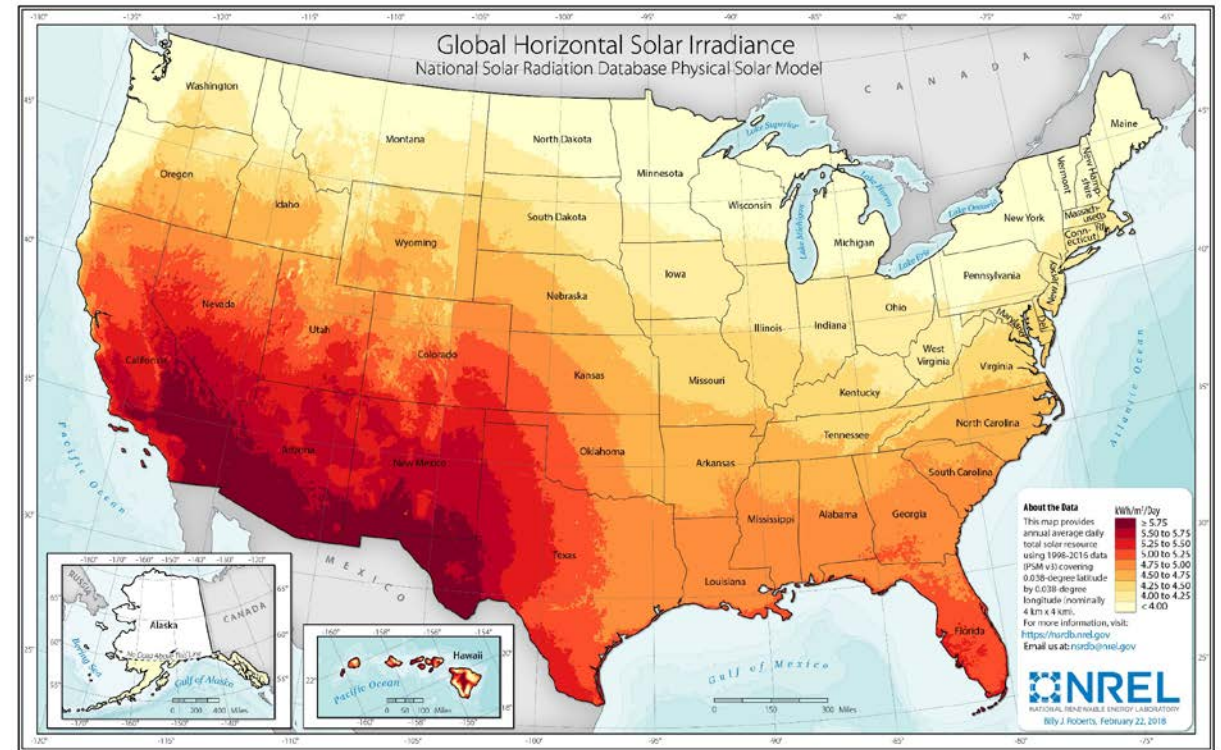


Image source: Roberts 2018

Solar PV Basics

- Commonly called “**solar panels**” or “**solar arrays.**”
- **Residential** and **commercial applications** of solar are widely adopted.
- Can be **paired with energy storage**, such as battery storage.
 - Using energy storage, solar energy produced during the day can be stored for later use.
 - Lithium-ion batteries commonly used.



Photo by Dennis Schroeder, NREL

Solar PV in Pennsylvania

Pennsylvania Annual Solar Installations and Cumulative Capacity (MWac)



Source: AEPS Qualified Facilities Report

Image source: Pennsylvania Department of Environmental Protection (n.d.), which cites AEPS Qualified Facilities Report, https://portal.pennaeps.com/app/publiccontroller/download_QFs/.

According to the Solar Energy Industries Association, at the end of 2023, Pennsylvania:

- Had lower growth of renewable energy adoption compared to other states in the region
- Ranked 26th among states for total installed solar capacity (1,491 MW, or enough to power 195,365 homes)
- Ranked 19th among states for solar jobs (4,288).

Source: SEIA (2024)

Residential Solar PV Considerations

- Potential considerations for homeowners considering rooftop solar PV:
 - ✓ How much electricity the household uses
 - ✓ How much electricity the household will use in the future
 - ✓ Solar potential (tree cover, nearby buildings that will shade panels)
 - ✓ Age of roof (damaged roof shingles, adequate structural support)
 - ✓ Neighborhood restrictions (limitations from homeowner associations or historic districts).



Solar PV in Pittsburgh. NREL Image 66338

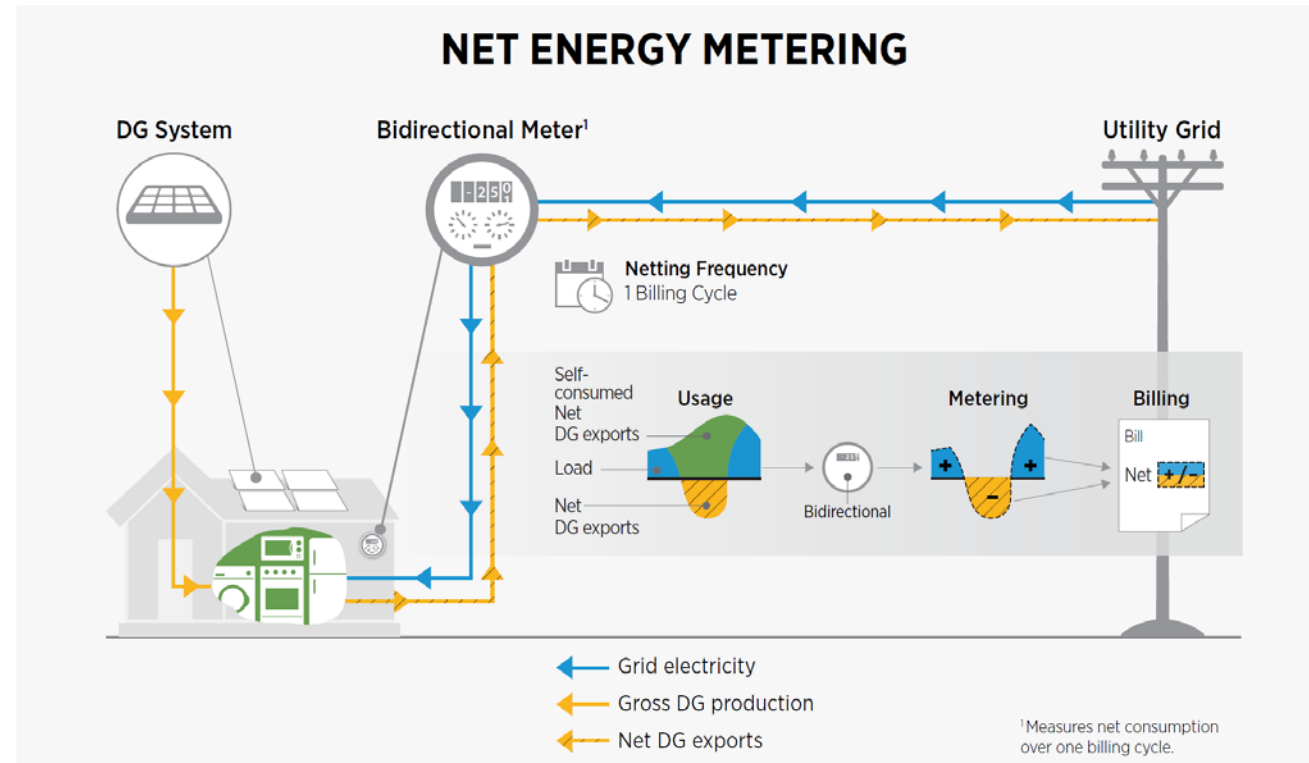
Residential Solar PV Compensation

Net energy metering (also referred to as net metering) allows solar PV system owners to export excess energy to the utility grid, receiving a credit that offsets consumption.

In Pennsylvania:

- Net metering is allowed for
 - Systems up to 50 kW for residential customers
 - Systems up to 3 MW for nonresidential customers.
- Investor-owned utilities are required to offer net metering.
- Electric generation suppliers* in Pennsylvania are permitted but not required to offer net energy metering (North Carolina Clean Energy Technology Center 2023).

*An electric generation supplier is a licensed entity that sells electricity to customers, using the transmission or distribution facilities of an electric distribution company (Pennsylvania Public Utility Commission). For more information, see: [PA Power Switch](#).



Net energy metering schematic. Image source: Aznar, et. al. 2017
"DG" = Distributed Generation

Rooftop Solar Example: Solarize Philly

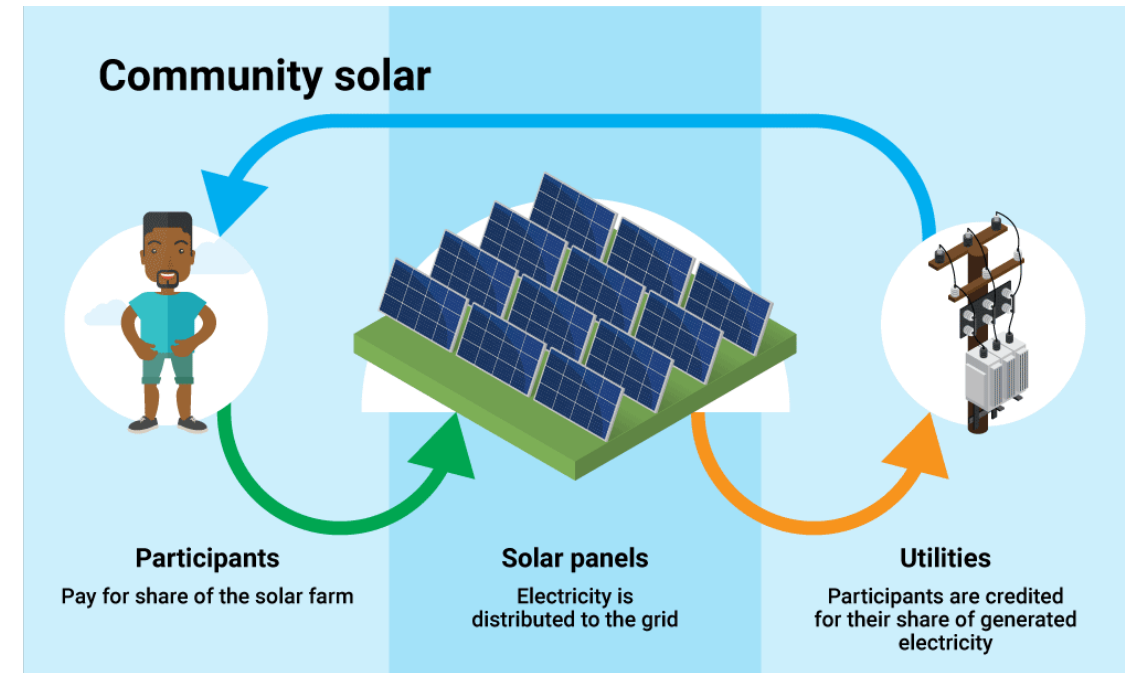
- The Philadelphia Energy Authority established Solarize Philly with the goal of making the process of installing solar easy and affordable.
- Solarize Philly has supported the installation of solar panels on over 2,000 roofs since its founding in 2017.
- In 2020, the Solar Savings Grant Program supported LMI households to participate in Solarize Philly.
 - Grants for LMI households are provided by the Philadelphia Energy Authority.
 - The Philadelphia Energy Authority provided a grant for a portion of a solar project costs.
 - Participants finance the remainder of the costs.
 - Allows for utility bill savings from the start.
- A leasing model is also available.
- For more information, see [PEA Solarize Philly](#).



Photo by Mercury Solar Solutions

Community Solar

- Solar energy development model that allows customer to **buy or lease** part of a larger **off-site shared PV system**.
- Customers **subscribe to project and receive credits** on their bills that offset energy costs.
- Customers can **enjoy the advantages of solar without installing their own system**.



How community solar works. Image from Coughlin et al. 2012

Community Solar State Policies

States with Community Solar Enabling Legislation

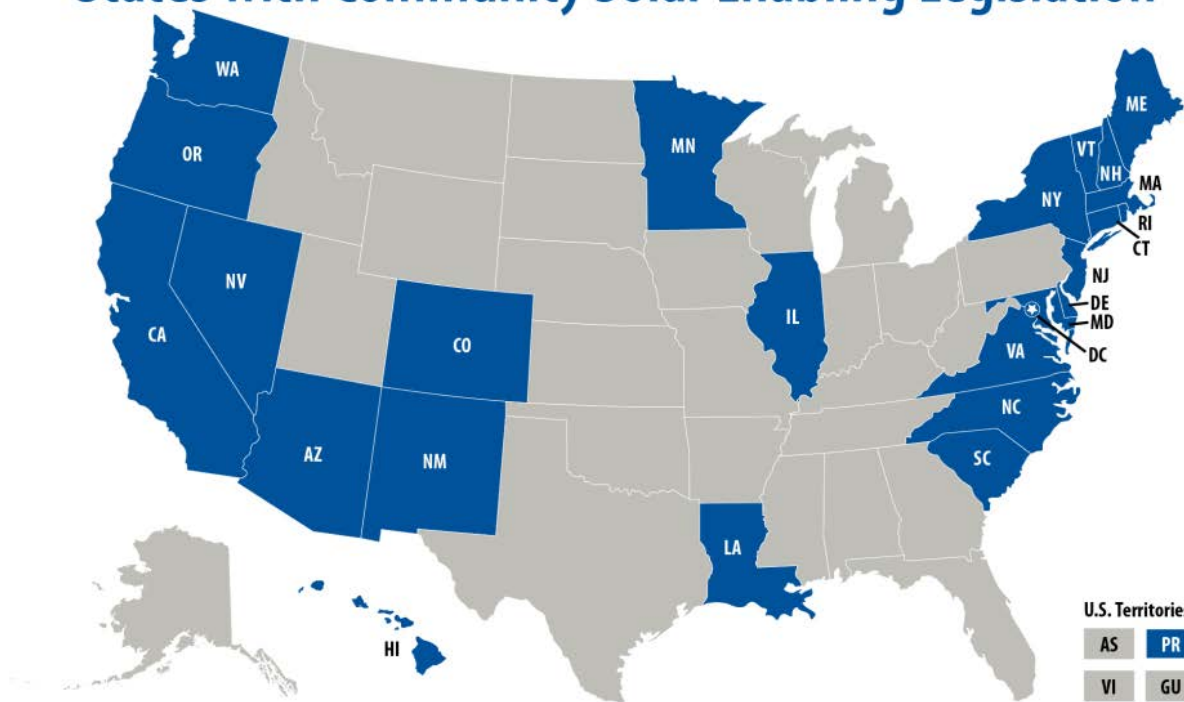


Image source: EPA (2024)

Community solar legislation has been enacted in 24 states, Washington, D.C., and Puerto Rico, as of November 2023.

Pennsylvania law does not allow community solar currently, though legislation to allow community solar has been proposed (Pennsylvania House Bill 1842; Regular Session 2023-2024).

Community Solar Example: Illinois Low-Income Community Solar Pilot

- Income-eligible (80% or less Area Median Income [AMI]) homeowners and renters can participate.
 - No upfront costs
 - Any ongoing costs or fees cannot exceed 50% of the value participants get from their system.
- Nonprofit organizations and public facilities can serve as anchor tenants (i.e., subscribe to a larger share of the project).
- Residents can only subscribe to community solar projects within their utility's service area.
- Community solar projects must meet these criteria:
 - Demonstrate community engagement
 - Supported by local community-based organizations.
- See [Illinois Solar for All](#) for more information.



Photo by Dennis Schroeder, NREL

Residential Clean Energy Incentives

Residential Clean Energy Credit (IRA 13302)

- [Residential Clean Energy Credit](#): 30% of the costs of new, qualified residential clean energy equipment installed between 2022 and 2033.
- Can be used for upgrades to a home owned or rented by the resident (must be a main home). Landlords cannot claim the credit.
- Eligible purchases:
 - Solar PV panels
 - Solar water heaters
 - Wind turbines
 - Geothermal heat pumps
 - Battery storage technology (starting 2023).
- [IRS FAQ](#)
- [Solar Energy Technologies Office \(SETO\) Homeowners Guide](#) (focused on solar PV).

Note: Low-income households can face challenges in claiming tax credits as a basis of taxes owed (Blanton 2021).

Information about federal tax credits is included here to raise awareness of available incentives but should not be considered tax advice. Refer to the [IRS guidance](#) for more information.

Federal Incentives for Solar Energy for Businesses

Investment Tax Credit

- Credit that reduces the federal income tax liability for a percentage of the cost of a solar system that is installed during the tax year.
- Credit is 30% of system installation costs for systems under 1 MW AC.
- Credit is 30% of system installation costs for systems over 1 MW AC if project meets wage and apprenticeship requirements, otherwise 6%.
- Tax-exempt entities are eligible to receive the Investment Tax Credit in the form of a direct payment, though not for leased systems.
- Bonus adders are available for domestic content, siting in energy communities, siting in low-income communities, siting on Indian land, or qualification as a low-income residential building project or economic benefit project.

Production Tax Credit

- The Production Tax Credit is a per kilowatt-hour (kWh) alternative to the Investment Tax Credit.

Information about federal tax credits is included here to raise awareness of available incentives but should not be considered tax advice. Refer to the [IRS guidance](#) or [SETO Guide on Solar Tax Credits for Businesses](#) for more information.

Summary of Investment Tax Credit (ITC) and Production Tax Credit (PTC) Values Over Time

		Start of Construction							
		2006 to 2019	2020 to 2021	2022	2023 to 2033	The later of 2034 (or two years after applicable year ^a)	The later of 2035 (or three years after applicable year ^a)	The later of 2036 (or four years after applicable year ^a)	
ITC	Full rate (if project meets labor requirements ^b)	Base Credit	30%	26%	30%	30%	22.5%	15%	0%
		Domestic Content Bonus				10%	7.5%	5%	0%
		Energy Community Bonus				10%	7.5%	5%	0%
	Base rate (if project does not meet labor requirements ^b)	Base Credit	30%	26%	6%	6%	4.5%	3%	0%
		Domestic Content Bonus				2%	1.5%	1%	0%
		Energy Community Bonus				2%	1.5%	1%	0%
	Low-income bonus (1.8 GW/yr cap)	<5 MW projects in LMI communities or Indian land				10%	10%	10%	10%
		Qualified low-income residential building project / Qualified low-income economic benefit project				20%	20%	20%	20%
	PTC for 10 years (\$2022)	Full rate (if project meets labor requirements ^b)	Base Credit			2.75 ¢	2.75 ¢	2.0 ¢	1.3 ¢
Domestic Content Bonus						0.3 ¢	0.2 ¢	0.1 ¢	0.0 ¢
Energy Community Bonus						0.3 ¢	0.2 ¢	0.1 ¢	0.0 ¢
Base rate (if project does not meet labor requirements ^b)		Base Credit			0.55 ¢	0.55 ¢	0.4 ¢	0.3 ¢	0.0 ¢
		Domestic Content Bonus				0.1 ¢	0.0 ¢	0.0 ¢	0.0 ¢
		Energy Community Bonus				0.1 ¢	0.0 ¢	0.1 ¢	0.0 ¢

^a "Applicable year" is defined as the later of (i) 2032 or (ii) the year the Treasury Secretary determines that there has been a 75% or more reduction in annual greenhouse gas emissions from the production of electricity in the United States as compared to the calendar year 2022.

^b "Labor requirements" entail certain prevailing wage and apprenticeship conditions being met.

Image source: Solar Energy Technologies Office (2023)

Pennsylvania Incentives for Solar Energy

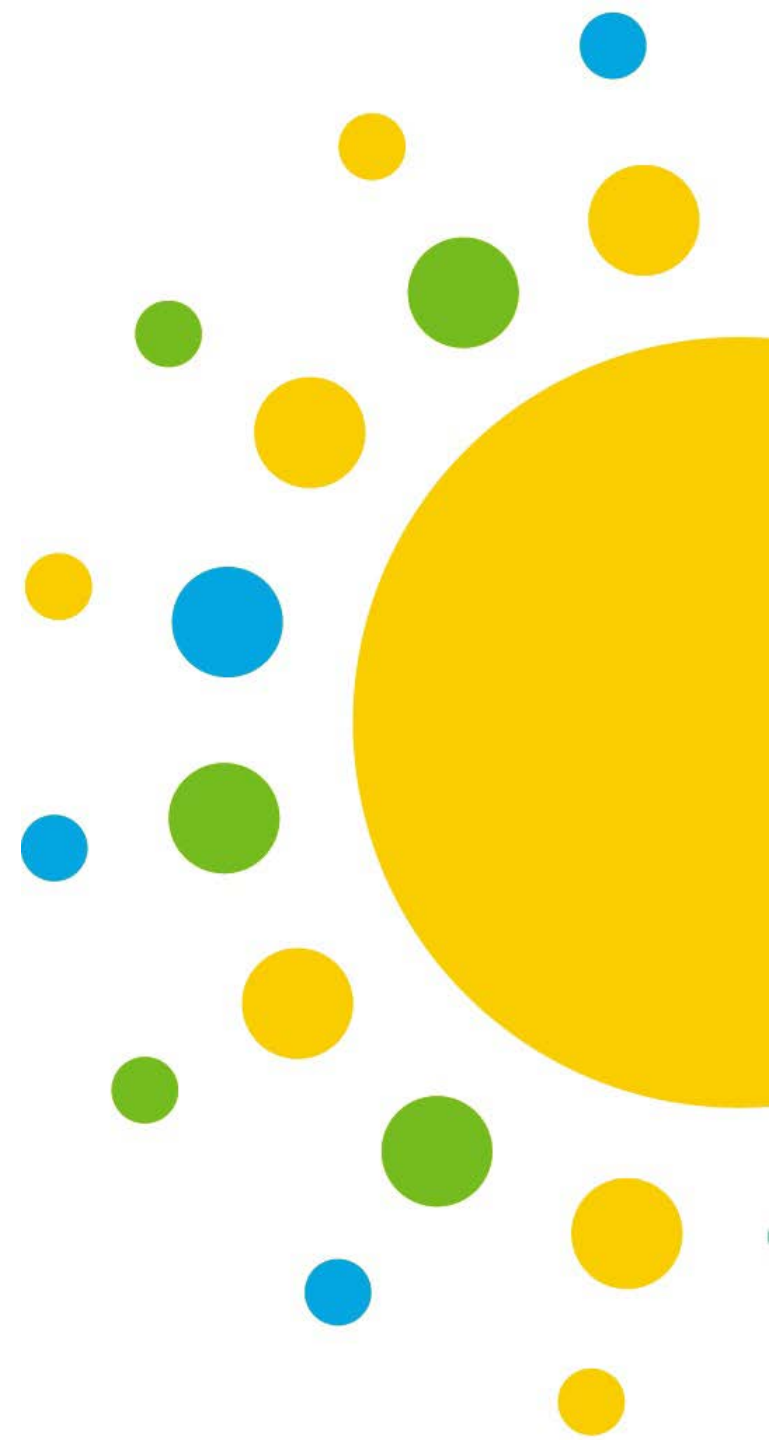
Property Assessed Clean Energy (PACE)

- Allows a property owner to finance the upfront cost of energy on a property and then pay the costs back over time through a voluntary assessment.
 - Assessment is attached to the property rather than an individual. Responsibility for financing transfers to new owner in case of sale.
- There is no residential PACE program in Pennsylvania.
- [Pennsylvania Commercial Property Assessed Clean Energy program.](#)



How the PACE process works. Image source: SCEP n.d.

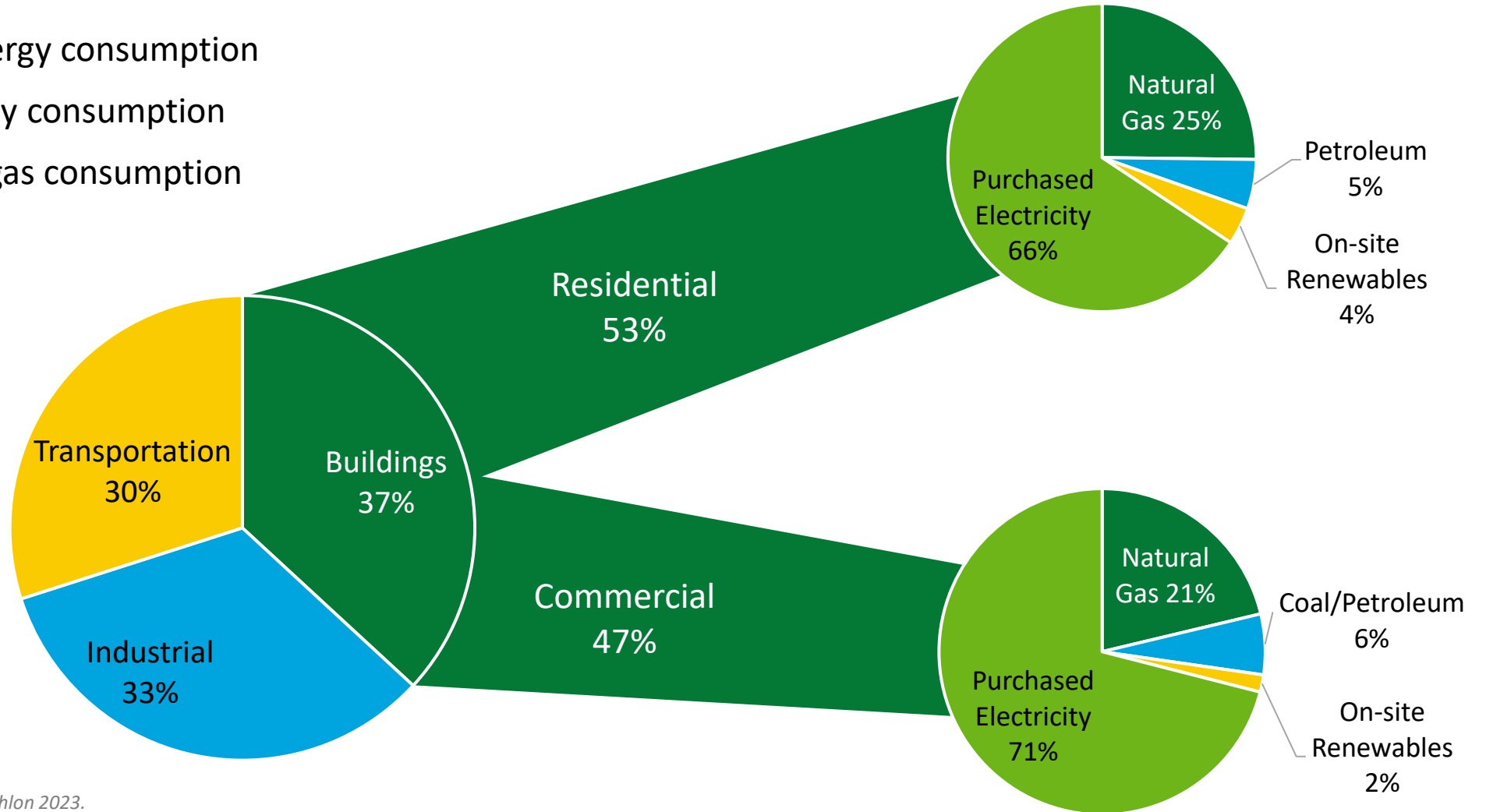
Residential Housing and Energy



Why Is Building Energy Use Important?

- 37% of total U.S. energy consumption
- 73% of U.S. electricity consumption
- 24% of U.S. natural gas consumption

2023 U.S. total energy consumption by end-use sector



Original chart source: DOE Solar Decathlon 2023.

Updated data source: U.S. Energy Information Administration 2024.

Energy Burden

- **Energy burden:** the percentage of gross household income spent on energy costs.
- Pittsburgh ranks **6th** in the nation for households struggling with **energy burden** and **2nd** among **minority households**. (City of Pittsburgh n.d.)



Image source: NREL (2023)

Energy Burden by Census Tract in the Pittsburgh, PA Area

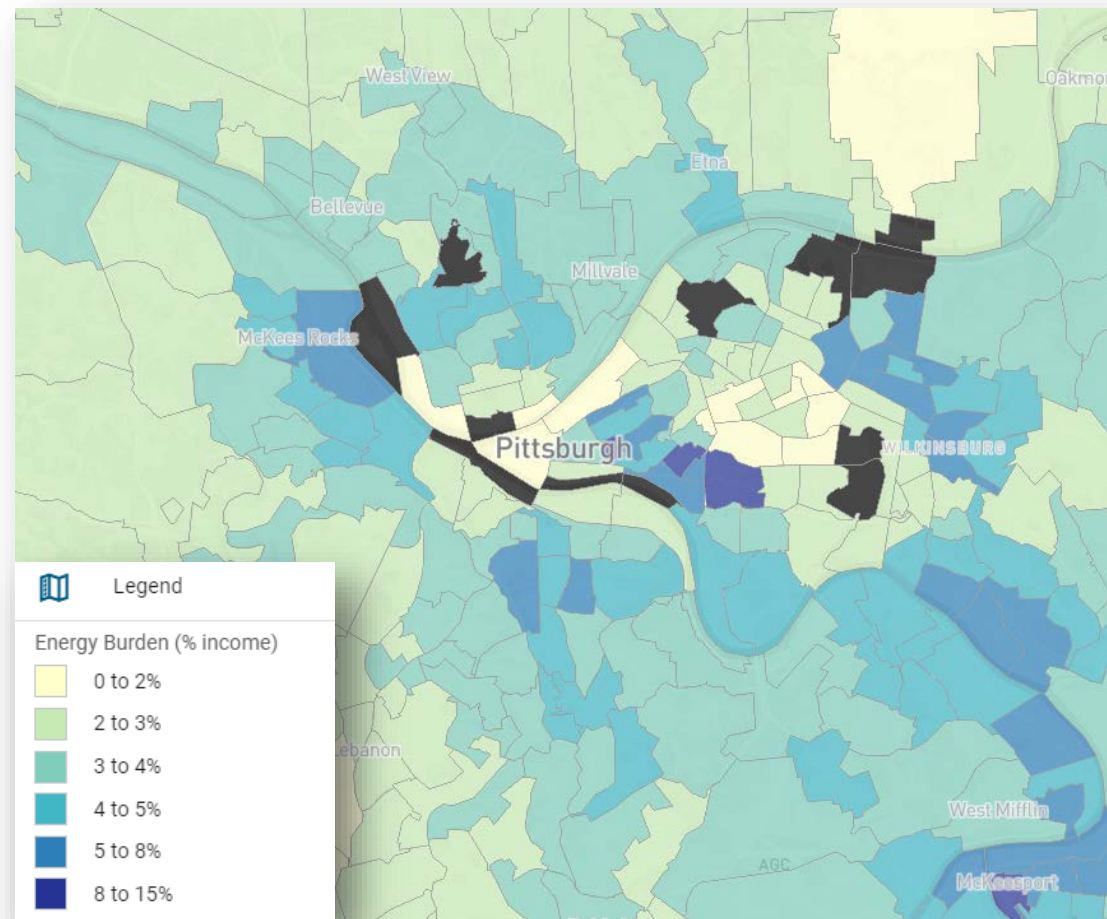


Image source: SCEP. N.d.[b]

Introduction: Residential Housing and Energy Efficiency

- Energy efficiency can yield [a wide range of benefits](#) on a community scale and household scale, including:
 - Household savings on energy bills
 - Increasing the resilience and reliability of the electric grid
 - Environmental, community, and health benefits.
- However, there are significant barriers to adoption for LMI households, minority households, small and minority businesses, and rural households and businesses (NREL 2023).

Key Barriers to Adoption of Energy Efficiency

Barriers	Description
Split Incentives	<ul style="list-style-type: none">• If renters pay for utilities, property owners may not be incentivized to invest in energy efficiency measures.• If property owners pay energy bills, the renters may not have an incentive to reduce energy use.
Federal Poverty Level and AMI Criteria	<ul style="list-style-type: none">• Households above Federal Poverty Level/AMI criteria thresholds may still be energy-burdened.• Households that meet federal poverty level/AMI criteria thresholds may not receive needed financial assistance.• Rural households are often ineligible for federal energy assistance due to lower income requirements in rural areas versus urban areas.
Access to Energy Efficiency Technologies	<ul style="list-style-type: none">• Energy efficiency technologies can be expensive, complicated to obtain and install, or not compatible with all households, often making upgrades to more efficient technologies inaccessible for low-income households.• Rural households face a lack of awareness and options for energy efficiency technologies, limited availability of technology options, and a trained workforce to properly install and maintain the systems.

Source: Clarke et al. (2023)

Key Barriers to Adoption of Energy Efficiency


Barriers	Description
Access to Low-Cost Capital for LMI Households and Minority Businesses; Lack of Wealth for Minority Households	<ul style="list-style-type: none">• Low-income households have a smaller accumulation of wealth and poor access to capital for home improvements.• White families have been shown to have eight times more wealth than African American families and five times more than Hispanic families (Bhutta et al. 2020).• 46% of white-owned businesses accessed credit from banks within the last 5 years, which is double that of businesses owned by African Americans (Raoul 2020).
Lower-Quality Infrastructure; Low Property Values	<ul style="list-style-type: none">• Low-income households often live in less energy-efficient buildings that may be more difficult and expensive to upgrade.• Rural households may have lower property values leading to less financial incentive to maintain the property and install new energy efficiency technologies.
Workforce	<ul style="list-style-type: none">• Specialists or trained contractor networks can be a challenge to find and hire in low-income and rural communities.

Source: Clarke et al. (2023)

Energy Efficiency Barriers: Additional Resources

- The [SB 350 Barriers Study](#) by the California Energy Commission examines barriers that low-income and disadvantaged communities face when considering adopting clean energy measures.
- [Oak Ridge National Laboratory researchers](#) summarize barriers and examine the persistent problem of high energy burdens among low-income households, based on a review of more than 180 publications.
- [The American Council for an Energy-Efficient Economy](#) describes energy efficiency barriers and challenges for low-income households.
- The [NYU Marron Institute of Urban Management](#) studied how energy efficiency barriers for lower-income households can be overcome through low-cost energy improvements, reducing energy costs by as much as \$1,500 per year.

Residential Energy Efficiency

- Energy-efficient homes and buildings **use less energy for heating, cooling, and running appliances** and electronics.
- **Energy efficiency is different from energy conservation.** 
 - Energy conservation and energy efficiency can be *used in balance* to reduce energy consumption.

Examples of Energy Conservation vs. Energy Efficiency

Energy Conservation	Energy Efficiency
Turning off the lights	Upgrading to LED lightbulbs
Turning down the thermostat in the winter or turning up the thermostat in the summer	Upgrading to energy-efficient heating, ventilating, and air conditioning systems, including heat pumps
Hang-drying laundry	Upgrading to an energy-efficient dryer

Weatherization

- **Weatherization:** improvements to a building to protect the inside of the building from the weather and to increase energy efficiency.
- The term “weatherization” is typically used in the context of the U.S. Department of Energy’s Weatherization Assistance Program (WAP).



Types of weatherization measures. Image source: SCEP. N.d.[c]

Building Envelope

- **Building envelope:** the assembly of elements comprising the exterior enclosure of a building, including walls, roof, foundation, windows, and doors.
- The envelope affects **comfort, natural lighting, ventilation, and energy** needed for heating and cooling

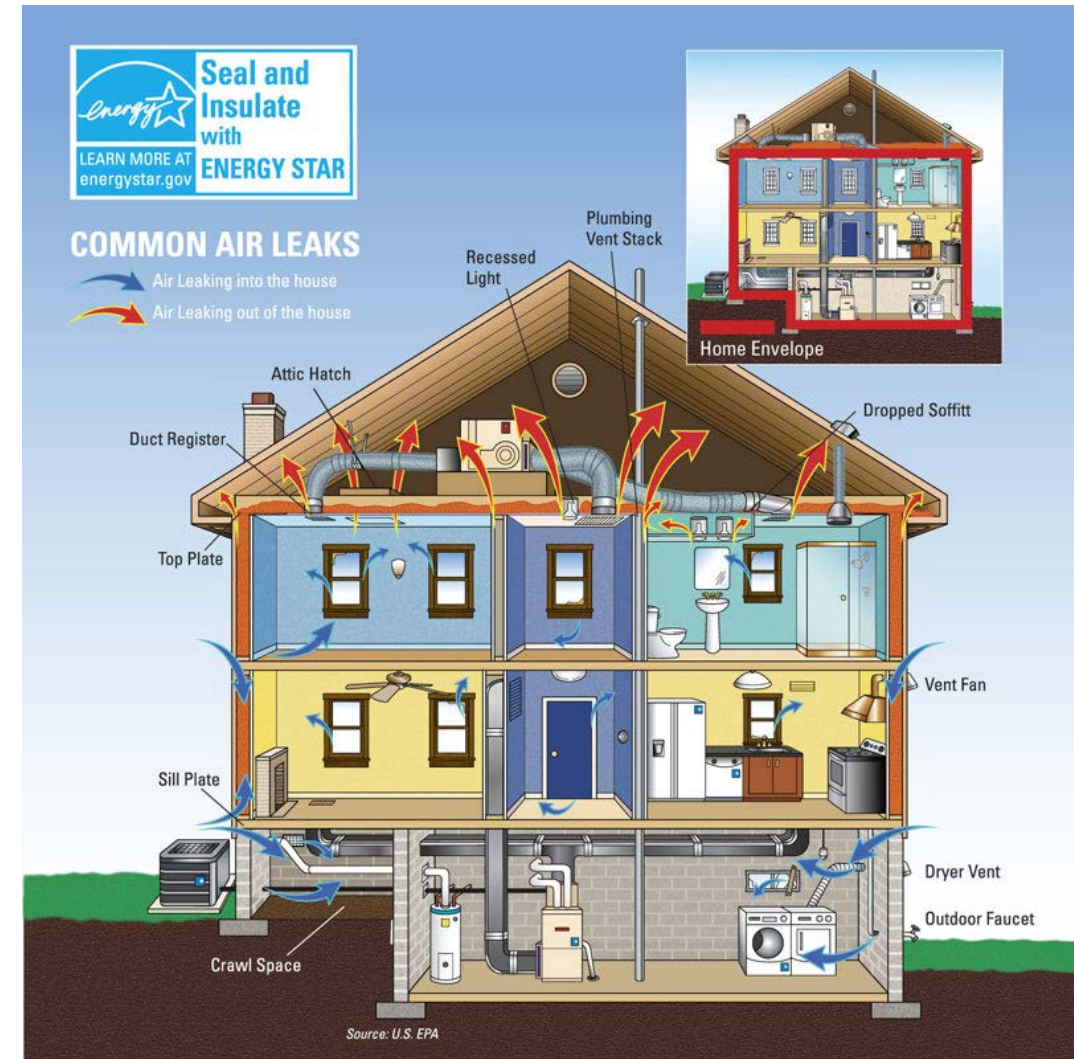


Image source: Building America Solutions Center n.d.

Infiltration and Exfiltration

- Infiltration/exfiltration: air leakage into and out of a home (DOE n.d.[a]).
- Why does infiltration matter?
 - A leaky house requires more energy and is more expensive to heat and cool; it can also be less comfortable for occupants.
 - Poor infiltration is linked to home health hazards, including asthma triggers such as mold and pests (DOE n.d.).

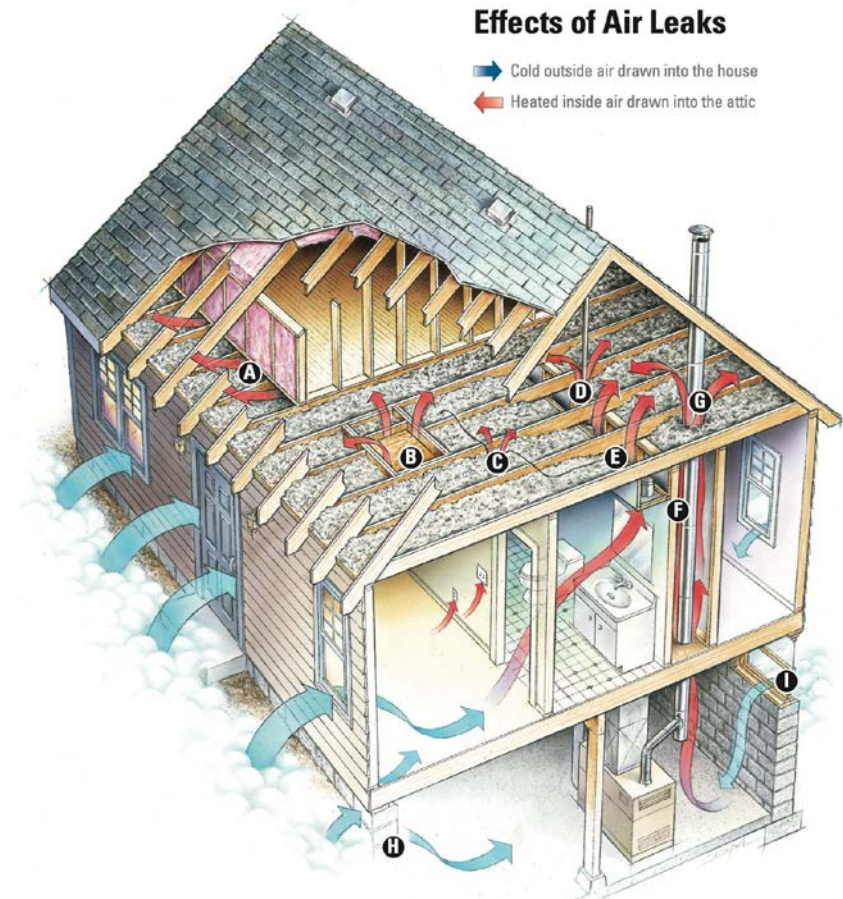
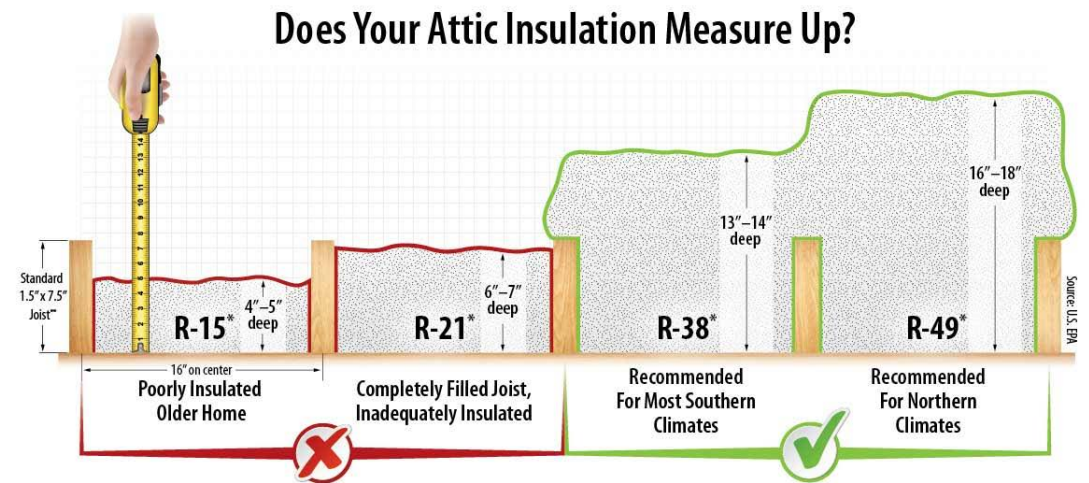


Image source: ENERGY STAR n.d.[a]

Insulation

- Insulation: keeps the house cooler in the summer and warmer in the winter.
- R-Value: measure of insulation's ability to resist heat traveling through it (e.g., for new single-family construction, ceiling insulation:
 - IECC 2009: R-38
 - IECC 2018: R-49 (Pittsburgh today)
 - IECC 2021: R-60 (EERE n.d.[a]).



* Recommended Dept. of Energy attic insulation levels for commonly used fiberglass, mineral wool, and cellulose insulation assuming about R-3 per inch.

** Standard joists are sold as 2" x 8" but usually measure closer to 1.5" x 7.5."

Ceiling insulation R-Values and acceptability for residential homes based on climate. Image source: ENERGY STAR n.d.[b]

Building Energy Audits

- **Determine where, when, why, and how energy is used in a home and identify opportunities to improve efficiency.**
- [DIY home energy audits](#) can address some efficiency solutions.
- In [professional home energy audits](#), a certified professional often inspects each room, conducts a blower door test and thermographic scan, and examines utility bills.
- [Duquesne Light's Income Eligible Energy Assessment](#) can investigate potential electric savings areas in the home.

For more information on energy audits, see the U.S. Department of Energy's Energy Saver site: [Home Energy Assessments](#).

Diagnostic Tools

Testing the airtightness of a home using a special fan called a blower door can help to ensure that air sealing work is effective. Often, energy efficiency incentive programs, such as the DOE/ EPA ENERGY STAR Program, require a blower door test (usually performed in less than an hour) to confirm the tightness of the house.

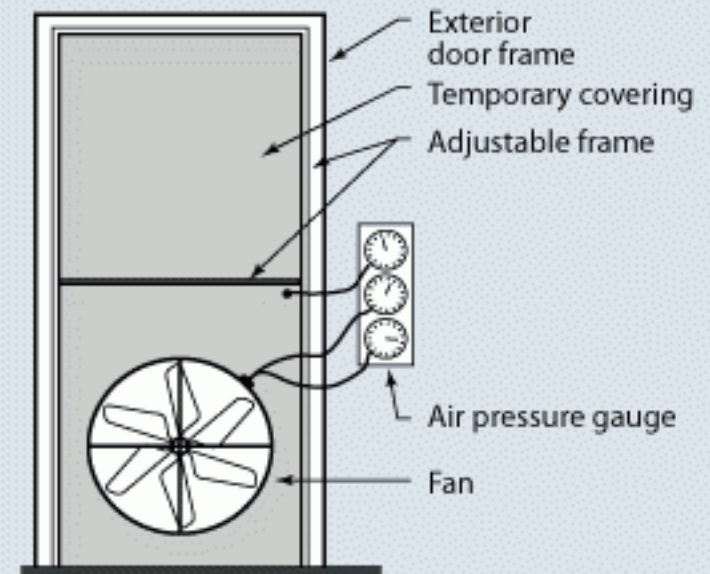


Image source: Energy.gov n.d.[b]

Building Energy Retrofit

- **Retrofit:** a retrofit is the addition of new technology or features to an older system. In the context of energy efficiency, a retrofit is a project to renovate or upgrade an existing structure with the intention of **improving energy performance**.
- A retrofit may also **improve occupant comfort, health, and safety**.



Insulation blown into an attic. Photo by Dennis Schroeder, NREL 17956

Residential Energy Efficiency Improvements

Insulation

Insulation may be installed in many areas of your home to lower heating and cooling costs and improve comfort. Insulation should be installed by a trained contractor to ensure proper placement.

Wall insulation

Exterior walls should be insulated, including between living spaces and unheated garages.

Foundation wall and rim joist insulation

Foundation wall and rim joist insulation may be installed to insulate the above-grade floor surface or foundation walls.



Air sealing

Caulking and weatherstripping are simple and effective air-sealing techniques to control possible comfort and moisture problems. Areas such as attics, doors, and windows can be sealed to reduce cold or hot air leakage into your home.

Attic insulation

Attic insulation may be installed within the ceiling or roof framing cavities.

Duct sealing and insulation

Duct sealing and insulation may be installed to prevent air loss due to leaks and holes. Ducts are the network of tubes in the walls, floors, and ceilings that carry air from your home's furnace or central air conditioner to each room.

Other efficiency upgrades

- Replace old lightbulbs with LEDs.
- Upgrade water heater efficiency.
- Upgrade HVAC system efficiency.
- Upgrade windows.
- Replace old doors.

Illustration by Besiki Kazaishvili, NREL.

Heating and Cooling

- Heating homes uses more energy and costs more money than any other system in a home.
- Combine energy-efficient equipment with proper equipment maintenance, insulation, air sealing, and thermostat settings to reduce energy use.
- Providing controlled ventilation as needed may be recommended alongside air sealing to manage indoor air quality.

For more information on heating and cooling, see the U.S. Department of Energy's Energy Saver site: [Home Cooling Systems](#), [Home Heating Systems](#), and [Air Sealing Your Home](#).



Air-source heat pumps. Image source: Energy.gov. n.d.[h]

Types of Heating Systems

Natural Gas

Furnace: furnaces heat air and distribute the heated air through the house using ducts.

Boiler: boilers heat water and provide either hot water or steam for heating. Steam is distributed via pipes to steam radiators, and hot water can be distributed via baseboard radiators or radiant floor systems or can heat air via a coil.

Electric

Furnace: blowers (large fans) in electric furnaces move air over a stack of electric resistance coils called elements. Heated air is delivered throughout the home through ducts.

Baseboard: electric baseboard heaters are electric resistance heaters controlled by thermostats in each room.

Heat pump: heat pumps (including air-source and geothermal heat pumps) use electricity to transfer heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. Because they transfer heat rather than generate heat, heat pumps can efficiently provide comfortable temperatures for your home.

See: Energy.gov (n.d.[d]), Energy.gov (n.d.[c]), Energy.gov (n.d.[g]).

Air-Source Heat Pump

- Uses electricity to transfer heat from a cool space to a warm space.
 - During the heating season, heat pumps move heat from the cooler outdoors into your warmer house.
 - During the cooling season, heat pumps move heat from your cooler house into the warmer outdoors.
- Because they transfer heat rather than generate heat, heat pumps can efficiently provide comfortable temperatures for your home.
- Can require additional electrical work (e.g., electrical panel upgrade) if replacing equipment with other fuel sources (e.g., natural gas furnace).

For more information on air-source heat pumps, see the U.S. Department of Energy's Energy Saver site: [Air-Source Heat Pumps](https://www.energy.gov/eere/buildings/energy-saver/air-source-heat-pumps).



Mini-split heat pump inside head unit. Image from Building America Solution Center



Ductless heat pump outside compressor. Image from Building America Solution Center

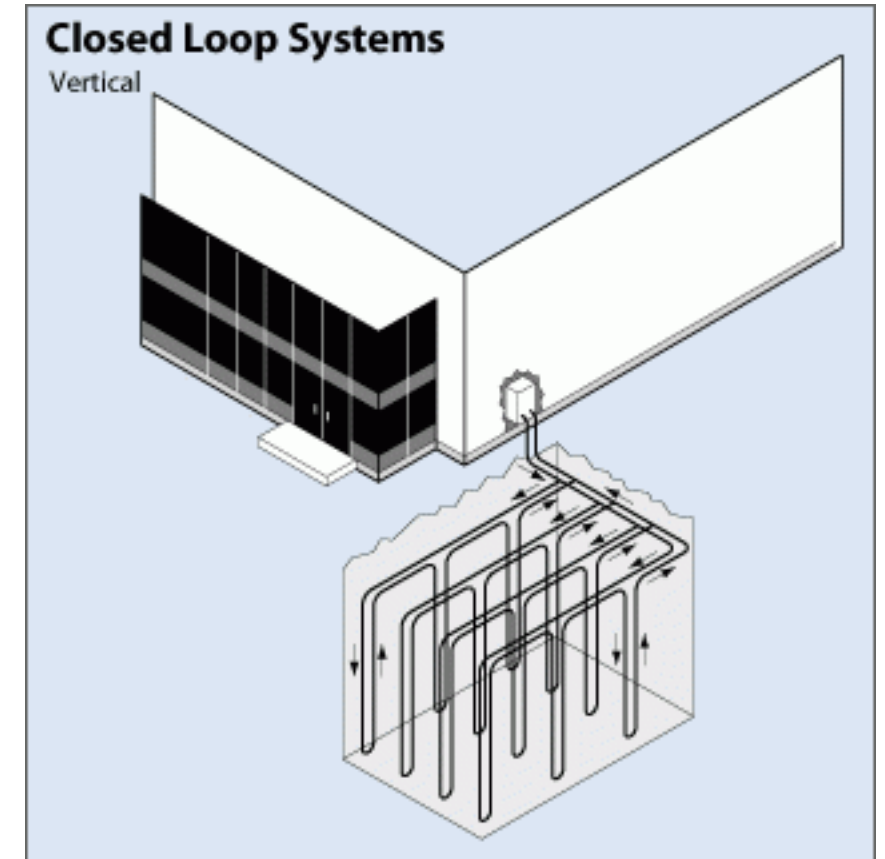


Ducted heat pump outside compressor. Image from Building America Solution Center

Geothermal Heat Pump

- Uses the relatively constant temperature of the earth for heat exchange instead of outside air.
- The price of a geothermal system can be several times that of an air-source system of the same capacity, but the additional costs may be returned in energy savings, depending on the cost of energy and available incentives.
- Water in abandoned underground mines has been used as a geothermal resource, such as for the John Wesley A.M.E. Zion Church system installed in 2006 in the Hill District, though this system type has not been widely deployed (Reisch and Sheils 2021).

For more information on ground-source heat pumps, see the U.S. Department of Energy's Energy Saver site: [Geothermal Heat Pumps](#). For more information on mine pool geothermal, see [Mine Pool Geothermal: Opportunities in West Virginia](#).



A vertical closed loop geothermal heat pump. Large commercial buildings and schools often use vertical systems because the land area required for horizontal loops would be prohibitive. Image source: Energy.gov (n.d.[f])

Hot Water

- Water heating is typically the second-largest energy expense in any home.
- Reduce energy consumption from water heating by:
 - **Fixing leaky fixtures** like faucets and showerheads or fixing leaky pipes
 - **Installing low-flow fixtures**
 - **Lowering the thermostat** on hot water heaters (within accepted ranges)
 - **Insulating water heaters** and pipes
 - **Replacing water heaters** with more-efficient models or types if upgrade is needed.

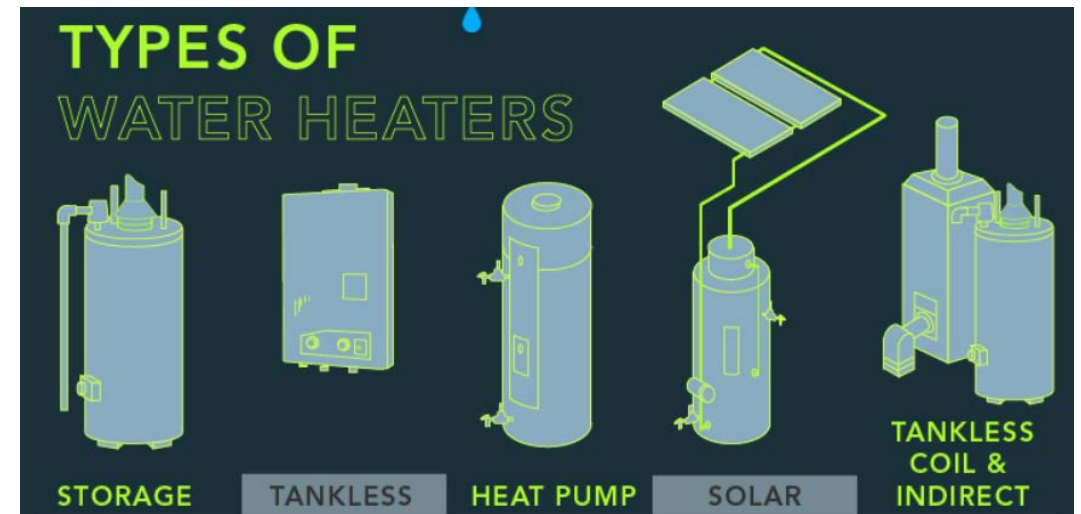


Image source: Energy.gov 2013

For more information on water heating, see the U.S. Department of Energy's Energy Saver site: [Water Heating](#), [Reduce Hot Water Use for Energy Savings](#), and [Selecting a New Water Heater](#).

Appliances and Lighting

- Reduce energy consumption from appliances and lighting by:
 - **Replacing appliances** with ENERGY STAR® versions, if upgrade is needed
 - **Removing extra appliances**, for example, an old garage fridge
 - **Replacing incandescent** light bulbs with **LED** bulbs
 - **Replacing a gas or conventional electric** cooking range with an **induction range**, if upgrade is needed.



Induction stove. NREL image 68807

For more information on appliances, see the U.S. Department of Energy's Energy Saver site: [Shopping for Appliances and Electronics](#), [Lighting Choices to Save You Money](#), and [Gas and Electric Ovens, Stoves, and Ranges](#).

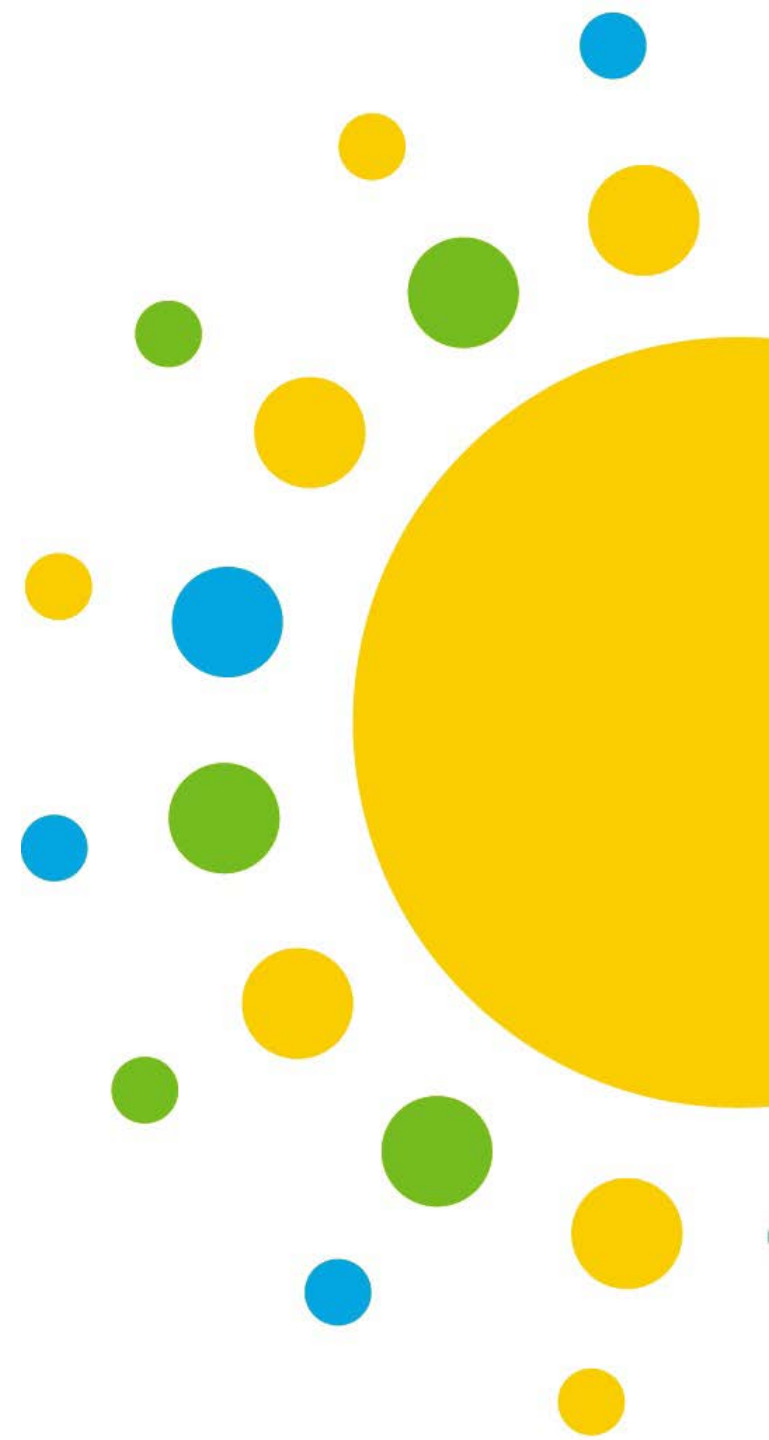
Residential Energy Efficiency Incentives

Extension, increase, and modification of new energy efficient home credit (45L) (IRA 13304)

- [Energy Efficient Home Improvement Credit](#): if a homeowner makes qualified energy efficiency improvements to their home, they may qualify for a tax credit up to \$3,200. The credit equals 30% of qualified expenses.
- Qualified expenses include energy efficiency improvements installed during the year, residential energy property expenses, and home energy audits.
- Maximum credits per year:
 - \$1,200 for energy property costs and certain energy-efficient home improvements
 - \$2,000 for qualified heat pumps, biomass stoves, or biomass boilers
 - No lifetime limit.
- [IRS FAQ](#).

Information about federal tax credits is included here for summary purposes only to raise awareness of available incentives but should not be considered tax advice. Refer to the [IRS guidance](#) for more information.

Solar and Energy Efficiency Examples and Resources



Resources To Support Low-Income Communities

Listed below are additional **programs and resources that** cover solar and energy efficiency, to support low-income communities in **addressing barriers to adoption:**

- [Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities: Case Studies and Program Profiles](#)
- [WAP](#)
- [Residential Retrofits for Energy Equity \(R2E2\)](#)
- [Clean Energy for Low Income Communities Accelerator Toolkit.](#)

Bringing the Benefits of Energy Efficiency and Renewable Energy to Low-Income Communities

The U.S. Environmental Protection Agency [published a series of case studies and program profiles](#) to highlight effective efforts by state and local agencies, nonprofits, and community-based organizations to bring energy efficiency and renewable energy to low-income and disadvantaged communities.

The agency created the first series of case studies in 2017 and the second series in 2024. Each case study includes information on the communities served, community engagement, key partners, funding, impact, barriers and challenges, and recommendations.

Case Study: District of Columbia Solar for All

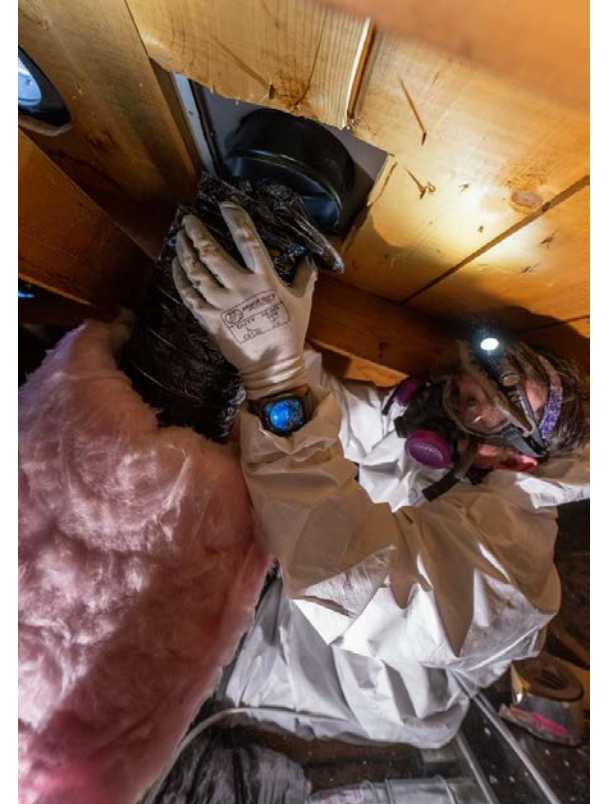
- [Solar for All](#) was launched in 2016 and is administered by the District of Columbia (DC) Department of Energy & Environment ([see case study here](#))
- Intended to bring the benefits of solar energy to LMI renters and homeowners.
- Includes no-cost solar installation at a single-family residence (participants own the panels) or participation in a community solar project.
- The case study noted that participants can expect to see their electricity costs reduced by about half.
- Has installed over 37 MW of new solar capacity, serving nearly 10,000 households.
- Includes a workforce sub-program called Solar Works DC, which has trained 385 people for entry-level jobs in solar and related industries as of August 2023.
- Funded primarily through the Renewable Energy Development Fund, which was initially established by DC's Renewable Energy Portfolio Standard Act of 2004.



Photo by Stefano Paltera / NREL

Case Study: EmPOWER Maryland

- In 2008, the Maryland Public Service Commission launched [the EmPOWER Maryland initiative](#), directing the state's electric utilities to develop energy efficiency programs.
- Administered by Maryland's six largest utilities and the Maryland Department of Housing and Community Development.
- Offers qualified low-income homeowners energy efficiency improvements at no cost.
- Has helped 21,000 low-income households, with average cost savings of \$340 per year per household.
- The upgrades are [funded by a monthly surcharge on customer utility bills that averages less than \\$6 per month](#).
- Every dollar invested in EmPOWER Maryland [returns \\$1.81 in benefits for Marylanders](#).



A contractor installing insulated exhaust fan ducting (an energy efficiency measure). Photo by Werner Slocum / NREL

WAP Overview

- Aims to reduce energy costs for low-income households by increasing energy efficiency, while supporting health and safety.
- DOE formula grants provided to states, Tribes, and territories.
- Local weatherization providers deploy weatherization measures.
- WAP funds may be used to implement renewable energy technologies like solar.

For more information, see the [2023 WAP Fact Sheet](#) and [Solar Resources in WAP and LIHEAP](#).

Allowable Weatherization Measures



Mechanical Measures

- Clean, tune, repair, or replace heating and/or cooling systems
- Install duct and heating pipe insulation
- Repair leaks in heating/cooling ducts
- Install programmable thermostats
- Repair/replace water heaters
- Install water heater tank insulation
- Insulate water heating pipes
- Install solar hot water heating systems.



Health & Safety Measures

- Perform heating system safety testing
- Perform combustion appliance safety testing
- Repair/replace vent systems to ensure combustion gas drafts safely outside
- Install mechanical ventilation to ensure adequate indoor air quality
- Install smoke and carbon monoxide alarms when needed
- Evaluate mold/moisture hazards
- Perform incidental safety repairs when needed.



Building Shell Measures

- Install insulation where needed
- Perform air sealing
- Repair/replace windows and doors
- Install window film, awnings, and solar screens
- Repair minor roof and wall leaks prior to attic or wall insulation.



Electric Baseload Measures

- Install efficient light sources
- Install low-flow showerheads
- Replace inefficient refrigerators with energy-efficient models.



Client Education Activities

- Educate on potential household hazards such as carbon monoxide, mold and moisture, fire, indoor air pollutants, lead paint, and radon
- Demonstrate the key functions of any new mechanical equipment or appliances
- Discuss the benefits of using energy-efficient products.

Image source: SCEP 2023

WAP in Pennsylvania

- **Program overview:**
 - Administered through the **Pennsylvania Department of Community and Economic Development**
 - **ACTION-Housing Inc.** is the **weatherization agency** for Allegheny County.
- **Eligibility:**
 - Low-income households (at or below 200% of the federal poverty level)
 - Priority to higher-risk residents such as the elderly, disabled individuals, families with children and high energy users.
 - Automatically eligible if an individual living in the dwelling receives Supplemental Security Income.

Table 2: 2024 Federal Poverty Guidelines

Persons in Family/ Household	2023 Federal Poverty Guideline (100%)	200% Federal Poverty Level
1	\$15,060	\$30,120
2	\$20,440	\$40,880
3	\$25,820	\$51,640
4	\$31,200	\$62,400
5	\$36,580	\$73,160
6	\$41,960	\$83,920
7	\$47,340	\$94,680
8	\$52,720	\$105,440

Source: ASPE (2024)

WAP Impact in Pennsylvania

- Since 2015, Pennsylvania has received \$150.8 million from WAP and \$16.8 million from the State Energy Program.
 - WAP and the State Energy Program are both funded by the DOE Office of State and Community Energy Programs.
 - Pennsylvania reduced energy costs and improved health and safety in 11,888 homes.
 - The average expenditure per household is \$7,669 depending on the home audit results.
 - The State Energy Program creates or retains* one job for every \$12,500 invested.
 - Pennsylvania has held 542 workshops, webinars, trainings, or outreach events since 2015 (SCEP 2023).



Image source: SCEP (2023)

*Retained jobs are jobs that would have been eliminated had the investment not been made.

WAP Resources

- [WAP homepage](#)
- [WAP fact sheet](#)
- [How to Apply for Weatherization Assistance](#)
- [Pennsylvania WAP](#)
- [Pennsylvania Weatherization Agency List.](#)

Residential Retrofits for Energy Equity (R2E2)

- R2E2 provides technical assistance to state, local, and Tribal governments, plus community-based organizations, to jump-start energy upgrades for single-family and multifamily affordable housing, especially in frontline communities.
- Partnership of the American Council for Energy-Efficient Economy, Elevate Energy, Emerald Cities Collaborative, HR&A Advisors, and the People's Climate Innovation Center.
- R2E2 is funded by the Rockefeller Foundation, JPMorgan Chase, Wells Fargo Foundation, and the JPB Foundation.

For more information, see the program website: [Residential Retrofits for Energy Equity \(R2E2\)](#).

Resources Distributed by R2E2

- The R2E2 Resources page includes a [Federal Funding FAQ](#) to answer questions regarding federal funding for energy efficiency retrofits for LMI housing.
 - This page provides information on programs made available through the Inflation Reduction Act.
- R2E2 offers [webinars](#) providing information on energy upgrade programs for low-income housing.
- The [AFFORD tool](#) (developed by RMI and the World Resources Institute) is designed to help users navigate and prioritize federal funding, tax credits, and other incentives, including around building energy upgrades.

Clean Energy for Low Income Communities Accelerator (CELICA)

- CELICA ran from 2016-2018 and aimed to better understand and **address energy challenges for low-income households**.
 - CELICA included **voluntary partnerships between the U.S. Department of Energy and 30+ stakeholders** from the public, private, and nonprofit sectors.
- CELICA demonstrated **locally designed** energy efficiency and distributed renewable energy solutions.
- CELICA produced a **toolkit** with an overview of **tools, resources, and models** for developing **low-income energy efficiency and renewable energy programs**.

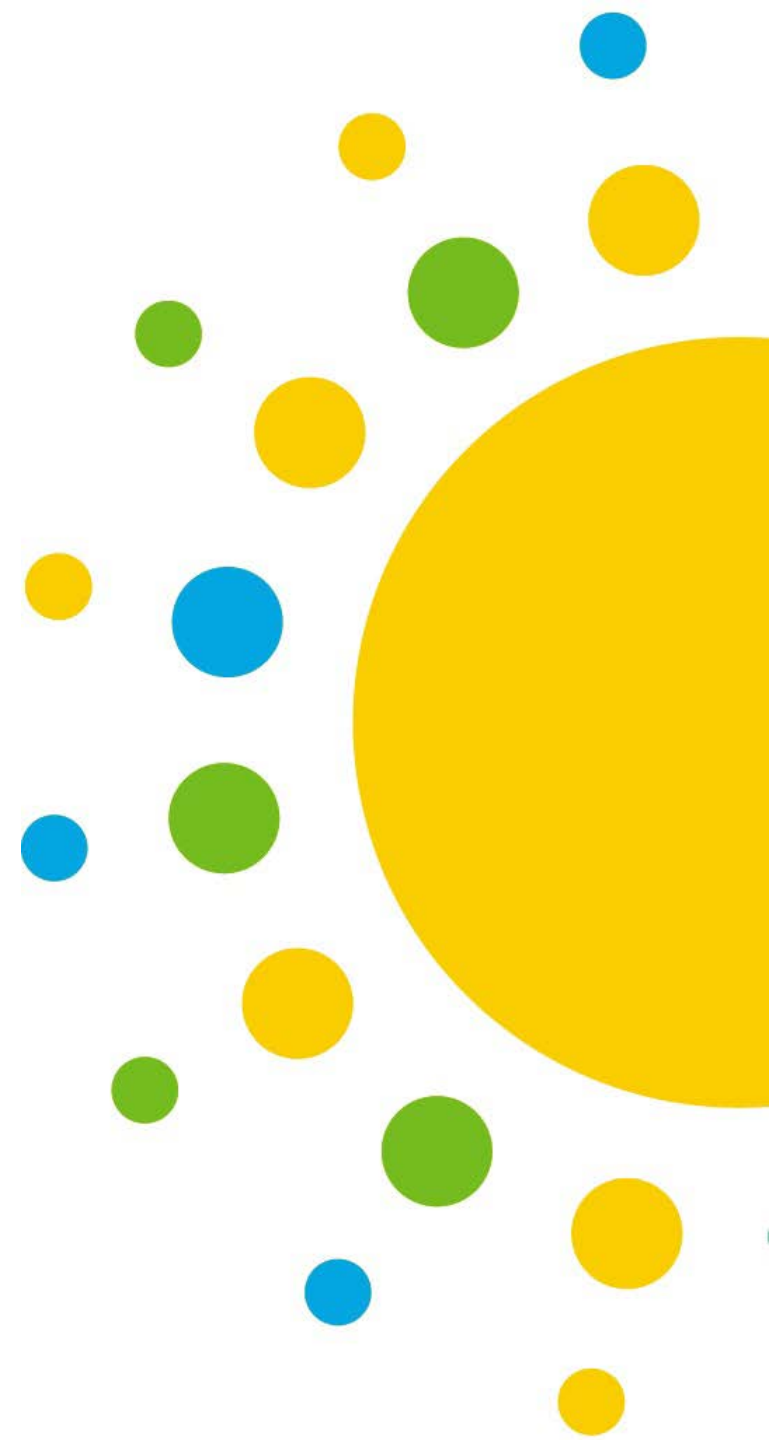
Access CELICA Resources

- [The Program Overview](#) page describes resources found in the toolkit.
- CELICA Program Models define the features of energy efficiency and clean energy programs by target market, key product and service attributes, resource flows, and benefits.
 - Models exist for [single-family housing](#), [multifamily housing](#), and [community solar](#).
- [The resource library](#) lists U.S. Department of Energy resources and links related to stakeholder engagement, community assessment and barriers analysis, action planning, and metrics and indicators.

Example CELICA Issue Brief

- [CELICA Issue Brief: Low-income Energy Efficiency Financing through On-Bill Tariff Programs](#) provides an overview of how on-bill tariffs can help address barriers to low-income home energy efficiency.
 - On-bill tariffs do not depend on consumer credit and do not require upfront investments from homeowners, building owners, or tenants.
 - With an on-bill tariff, the utility pays for home energy improvements and recovers its cost through a monthly utility bill charge.
 - The utility bill charge is less than estimated savings from the improvements.

Pittsburgh Home Repair and Energy Efficiency Programs



Organization Name	Key Services	Key Programs
ACTION-Housing Inc.	<ul style="list-style-type: none"> • Home repairs • Accessibility modifications • Weatherization and energy efficiency upgrades 	WAP
		Whole-Home Repair Program
Urban Redevelopment Authority	<ul style="list-style-type: none"> • Home repairs • Accessibility modifications • Weatherization and energy efficiency upgrades 	Homeowner Assistance Programs
		Homeowner Assistance Program for Independence
Rebuilding Together Pittsburgh	<ul style="list-style-type: none"> • Home repairs • Accessibility modifications 	Affordable Housing Repair
		Safe and Healthy Homes
Habitat for Humanity of Greater Pittsburgh	<ul style="list-style-type: none"> • Home repairs • Accessibility modifications 	Home Repair Program
Duquesne Light Company	<ul style="list-style-type: none"> • Home energy assessments • Energy efficiency 	Income Eligible Energy Assessment

ACTION-Housing Inc.

**Current as of May 2024;
information subject to
change in the future.**

Organization Name	Key Services	Key Programs	Eligibility Requirements	Description of Services
ACTION-Housing Inc.	<ul style="list-style-type: none"> Home repairs Accessibility modifications Weatherization and energy efficiency upgrades 	WAP	At or below 200% poverty level	Provides free energy efficiency upgrades to income-eligible homeowners and renters (with landlord approval) at or below 200% of poverty level. Energy Auditor conducts audit of home to assess measures that will increase energy efficiency and reduce energy costs.
		Whole-Home Repair Program	At or below 80% AMI	Limited program that provides eligible homeowners with up to \$50,000 per owner-occupied unit in repairs to address habitability, safety, and energy efficiency.

Program Access

- Call 412-281-2102 and/or email wxapps@actionhousing.org
- [Our Services](#)
- [Allegheny County Whole-Home Repairs Program.](#)

Urban Redevelopment Authority

**Current as of May 2024;
information subject to
change in the future.**

Organization Name	Key Services	Key Programs	Eligibility Requirements	Description of Services
Urban Redevelopment Authority	<ul style="list-style-type: none"> Home repairs Accessibility modifications Weatherization and energy efficiency upgrades 	Homeowner Assistance Programs	At or below 80% AMI	Provides up to \$35,000 in financial assistance to eligible homeowners at or below 80% of AMI for rehabilitating and improving residential owner-occupied properties. Financial assistance is provided in the form a 0% interest, 20-year deferred loan.
		Homeowner Assistance Program for Independence	At or below 120% AMI	Grants to assist eligible homeowners and landlords to construct accessibility modifications to homes, including exterior ramps, chair lifts, and bathroom modifications. Eligible homeowners receive a grant from \$1,000-\$15,000 for a single-unit home. Landlords receive grants up to \$7,500 per unit.

Program Access

This program is currently not accepting new applications.
For more information, see the [program website](#).

Rebuilding Together Pittsburgh

**Current as of May 2024;
information subject to
change in the future.**

Organization Name	Key Services	Key Programs	Eligibility Requirements	Description of Services
Rebuilding Together Pittsburgh	<ul style="list-style-type: none"> Home repairs Accessibility modifications 	Affordable Housing Repair	Lived in the home for at least the past 3 years; at or below 60% AMI.	Provides home repairs and safety modifications for low-income homeowners. The program is focused on issues like sanitation, roofing, mold, energy efficiency, air quality, and comfort.
		Safe and Healthy Homes		Provides free home repairs and critical health and safety improvements to seniors, veterans, and people with disabilities.

Program Access

- [Apply](#)
- Call 412-247-2700.

Current as of May 2024; information subject to change in the future.

Habitat for Humanity of Greater Pittsburgh

Organization Name	Key Services	Key Programs	Eligibility Requirements	Description of Services
Habitat for Humanity of Greater Pittsburgh	<ul style="list-style-type: none">• Home repairs• Accessibility modifications	Home Repair Program	See website for limited income guidelines	Provides home repairs completed primarily by volunteers. Low- or no-interest loans may be available to help finance the cost of the work. Repairs can be minor to extensive, including painting, window repair, and accessibility modifications, as well as energy efficiency improvements like doors, windows, heating/cooling systems, air sealing, and insulation.

Program Access

- Complete the [interest form online](#)
- Call 412-450-8520, ext. 10
- [Home Repair page.](#)

Duquesne Light Company

**Current as of May 2024,
information subject to
change in the future.**

Organization Name	Key Services	Key Programs	Eligibility Requirements	Description of Services
Duquesne Light	<ul style="list-style-type: none">Home energy assessmentsEnergy efficiency	Income Eligible Energy Assessment	See website for limited income guidelines	Income-eligible customers receive a free energy assessment and investigation of potential opportunities for electric savings in their homes. Certain energy reduction measures can be installed where needed.

Program Access

- Call [1-866-282-3147](tel:1-866-282-3147)
- Have the following information available:
 - Ten-digit Duquesne Light account number (located at the top of Page 1 of your bill)
 - Monthly and/or yearly income of all household members
 - Contact phone number(s).

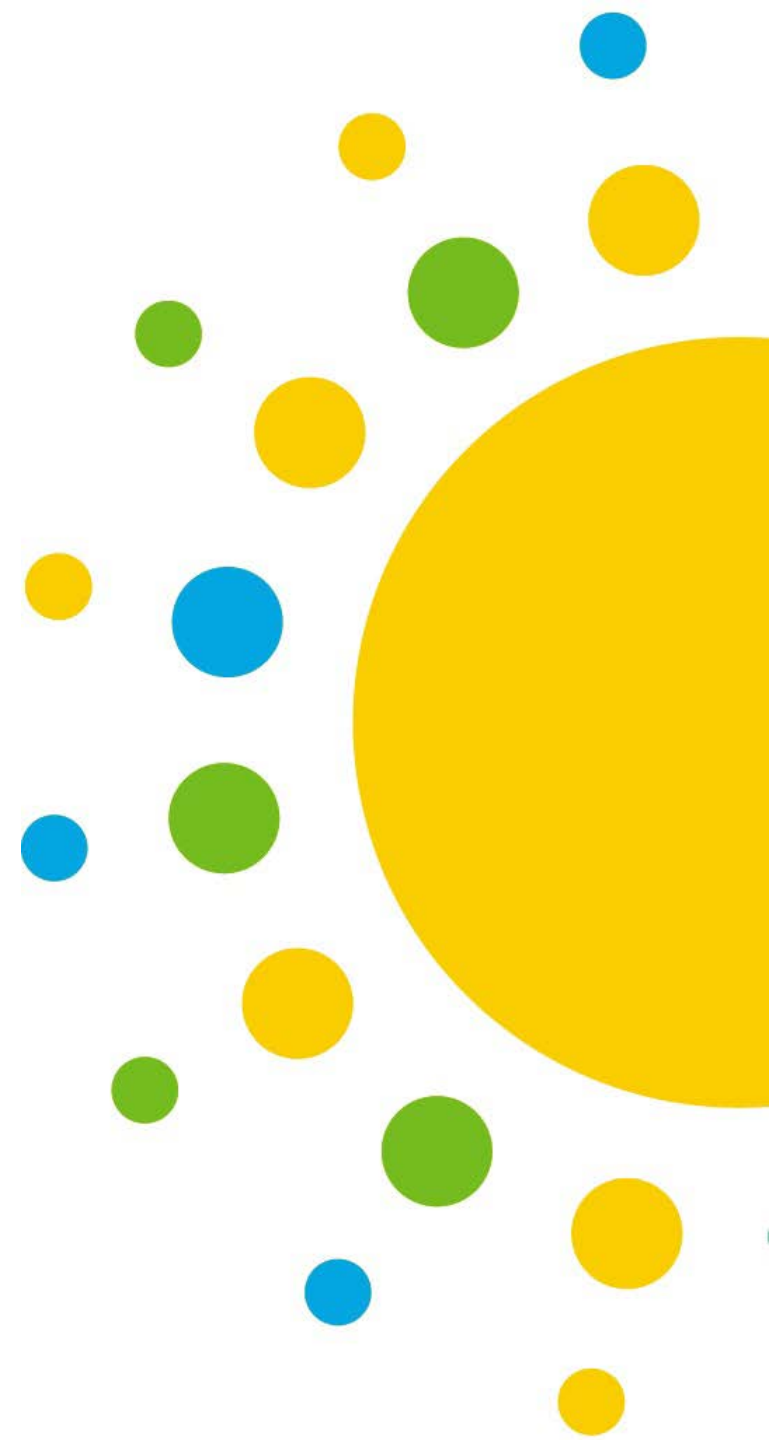
Income Eligibility Caps in Pittsburgh

% AMI Requirements*	1 Person	2 Persons	3 Persons	4 Persons
30%	\$19,950	\$22,800	\$25,650	\$28,450
50%	\$33,200	\$37,950	\$42,700	\$47,400
60%	\$39,840	\$45,540	\$51,240	\$56,880
80%	\$53,100	\$60,700	\$68,300	\$75,850

*Refers to 2022 Pittsburgh AMIs.

Source: ACTION-Housing Inc.
(n.d.)

Energy Resilience



Introduction: Energy Resilience

Energy resilience can help communities withstand and recover from power outages and natural disasters, **promoting health, safety, and economic outcomes for residents (DOE).**



Photo by Andrew Hudgins, NREL 41773

For more resources and a deeper dive into energy resilience, see [Community Resilience Options: A Menu for Enhancing Local Energy Resilience.](#)

Resilience Definition

Resilience: the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions through adaptable and holistic planning and technical solutions (Kramer, Belding, and Coney 2023).



A solar-plus-storage project can improve the resilience of a system. Image: NREL 14479

Distributed Energy Resources

- **Distributed energy resources** are resources connected to the distribution system*, including technologies such as solar PV, wind, energy storage, and diesel generators.
- Energy efficiency, demand response, and electric vehicles are also sometimes considered distributed energy resources.



Photo by Werner Slocum / NREL



Photo from Bergey Windpower

*The distribution system is the portion of the grid that delivers energy to end-use customers. The smaller, lower-voltage power lines and transformers in a residential neighborhood are examples of distribution system infrastructure.

Battery Energy Storage Systems

- Battery energy storage systems store energy and then supply that energy when needed, or at the most valuable time for the battery's owner.
- Battery energy storage systems can **add resilience and reliability to an energy system**, if designed to do so, by:
 - Providing backup power during outages
 - Storing excess renewable energy and supplying it during times of greater need
 - Providing services to the grid to support reliable operations.



Utility-scale lithium-ion battery energy storage system installation. NREL Image 31411.

Microgrid Basics

- A group of interconnected loads (e.g., businesses, homes) and distributed energy resources (e.g., solar PV, battery storage) that acts as a single controllable entity with respect to the grid.
- Power is supplied on-site, and, if designed to do so, the microgrid can “island,” or electrically isolate, from the electric grid.
- Microgrids may involve multiple generation sources and supply multiple buildings or be confined to a single small area like a resilience hub.

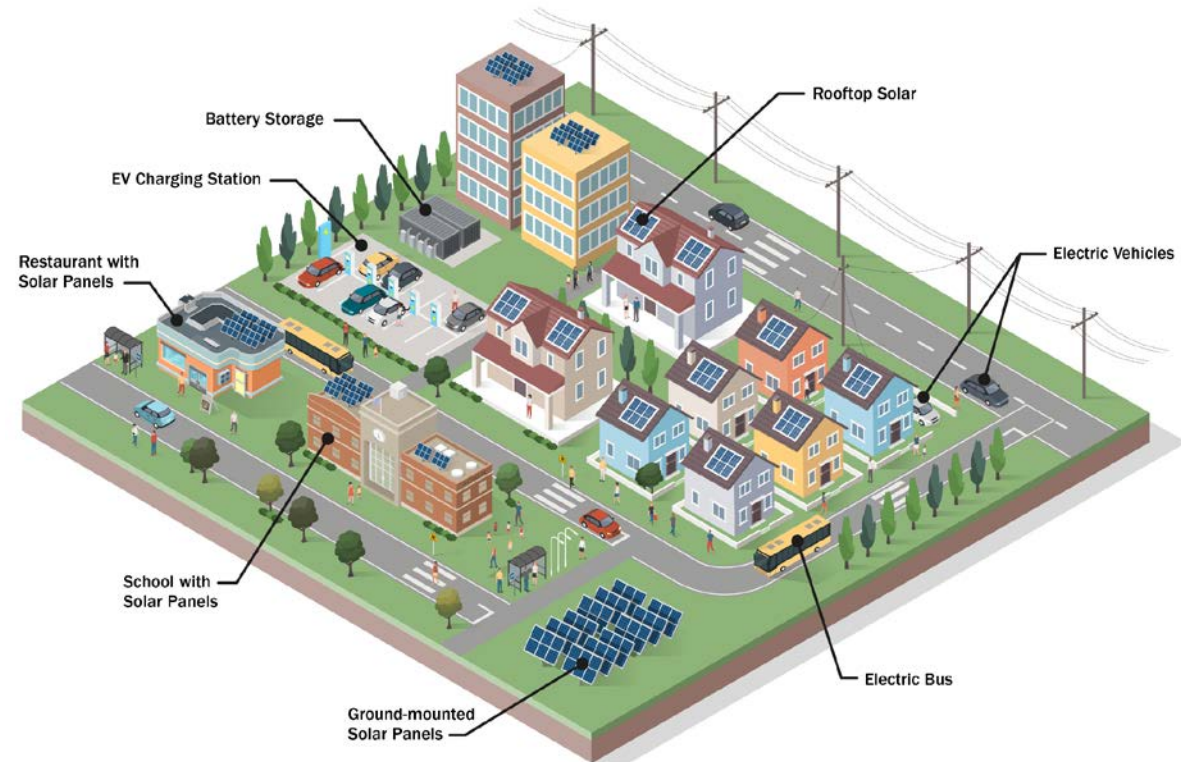


Image source: NREL 2023

Microgrid Benefits

- Advanced microgrids enable local power generation assets—including traditional generators, renewables, and storage—to keep the local grid running even when the larger grid experiences interruptions or, for remote areas, where there is no connection to the larger grid.
- In addition, advanced microgrids allow local assets to work together to save costs, extend the duration of energy supplies, and produce revenue via market participation.

Source: NREL (n.d.)

Microgrids vs. Distributed Generation

	Customer-Sited Distributed Generation	Customer-Sited Distributed Generation + Storage	Microgrid
Example System	Rooftop solar PV on a single commercial building	Rooftop solar PV on a single commercial building with an on-site battery storage system	Rooftop solar PV on multiple buildings on a campus + a battery storage system on campus + additional equipment (e.g., equipment to support islanding)
Backup Power	No backup power, but could support a future microgrid	Could provide backup power, with additional equipment (e.g., equipment to support isolation for safety)	Backup power for multiple loads or an entire site
Upfront Costs	Lower cost	Higher cost than customer-sited distributed generation (for storage and controls)	Much higher cost for additional required equipment, controls, and communication

Increasing project costs and complexity.
Increasing potential for additional services, cost savings, and/or revenue streams.

Table adapted from Lightner et al. (2020).

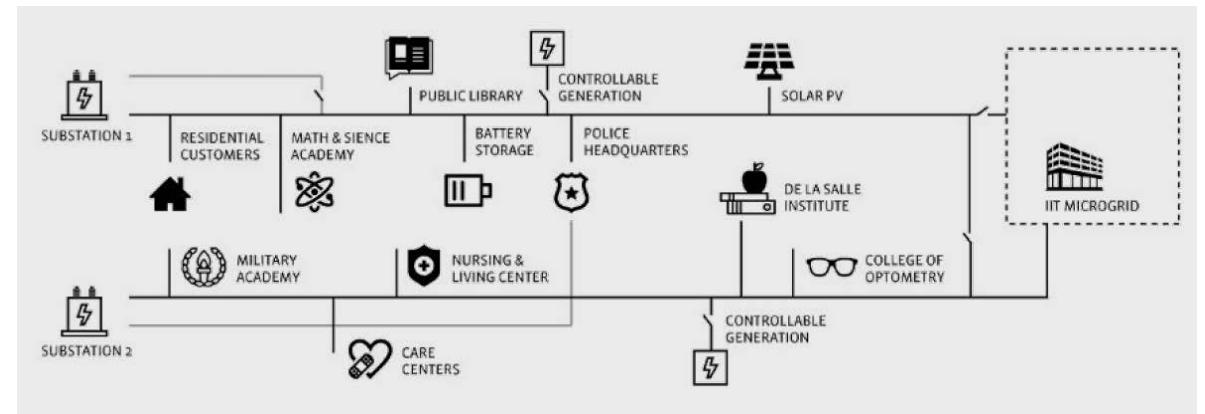
Microgrid Example: Bronzeville Community

Goals

- Provide resilience benefits (i.e., for the energy system, community, and critical infrastructure) (ComEd 2020)
- Lower greenhouse gas emissions
- Research and development
- Economic development (e.g., equitable participation in the new green economy) (Henderson 2021)
- Job creation (e.g., ComEd Construct Program) (ComEd n.d.).

Specifications

- 7.7-MW microgrid (Gurong et al. 2022)
- 1,060 customers served (Illinois Commerce Commission 2018)
- 4.8-MW natural gas generator (Pandey et al. 2021)
- 750 kW of solar PV
- 0.5-MW/2-MWh battery



The Bronzeville microgrid system.
Image source: Lightner et al. (2020)

Microgrid Example: Bronzeville Community

Sources of Capital

- The cost of the Bronzeville Community Microgrid project was estimated at \$25 million in 2018 (Illinois Commerce Commission 2018).
- The 2016 U.S. Department of Energy SHINES program awarded ComEd \$4 million for solar PV and battery to support development (EERE n.d.).
- Between 2016 and 2020, ComEd received about \$24 million in additional funding from the U.S. Department of Energy and other third-party partners to support development (Illinois Commerce Commission 2021).
- In 2020, the U.S. Department of Energy awarded ComEd three additional grants, resulting in about \$10 million from the department and other third-party partners to support development (Illinois Commerce Commission 2021).

Resilience Hub

- **Resilience hubs** are collections of services and resources that support communities before, during, or after a disaster or disruptive event. They improve resilience by providing critical resources that may include electricity, shelter, fresh water, food, programming, medical services, a hub for emergency responders, and other supplies needed in an emergency and afterward during the recovery process (NREL 2023).
- Open in times of emergency but also during everyday “steady-state” periods (DOEE n.d.).



Image: ready.gov

What Makes a Hub “Resilient”?

A hub may provide the following services that build resilience...



Access to electricity, heating, and cooling via a renewable and resilient power system



Food, tools, resources, and sometimes shelter



Backup water supply



Information, communication infrastructure, and streamlined information-sharing and coordination of resources



Logistical coordination with partner groups that provide aid and post-disruption support



Access to basic health and medical supplies

Resilience Hub Example: Baltimore, Maryland

[Baltimore, Maryland Community Resiliency Hub Program](#)

- Goal: better connect frontline community organizations with support and resources so that, in the event of a natural disaster or emergency, provision of emergency response and recovery services to under-resourced neighborhoods is improved.
- Partnership between service-based community organizations, the Office of Sustainability, Office of Emergency Management, and Department of Health.
- Grant funding continues to support the deployment of solar PV and battery storage, with backup power capabilities to support resilience, reduce energy burden for community organizations, and provide training and workforce development opportunities.
 - The Maryland Energy Administration's [Resilient Maryland Program](#) has provided grant funding to support resilience hubs in Baltimore through this program.
 - Four resilience hubs were equipped with solar PV and battery storage systems as of 2023.

Resilience Hub Example: Millvale, Pennsylvania

[Millvale, Pennsylvania, EcoDistrict](#)

- Second certified EcoDistrict in the world by the [Portland, Oregon-based nonprofit EcoDistricts](#).
- Includes the [Millvale Community Library](#) (internet access, education opportunities, programs, and summer camps)
- Includes the [Millvale Food + Energy Hub](#) in the former Moose Lodge (coworking space, kitchen, 412 Food Rescue base for Good Food Program, training, community activities)
- Solar panels installed on the Millvale Community Library and Millvale Food + Energy Hub for energy resiliency.

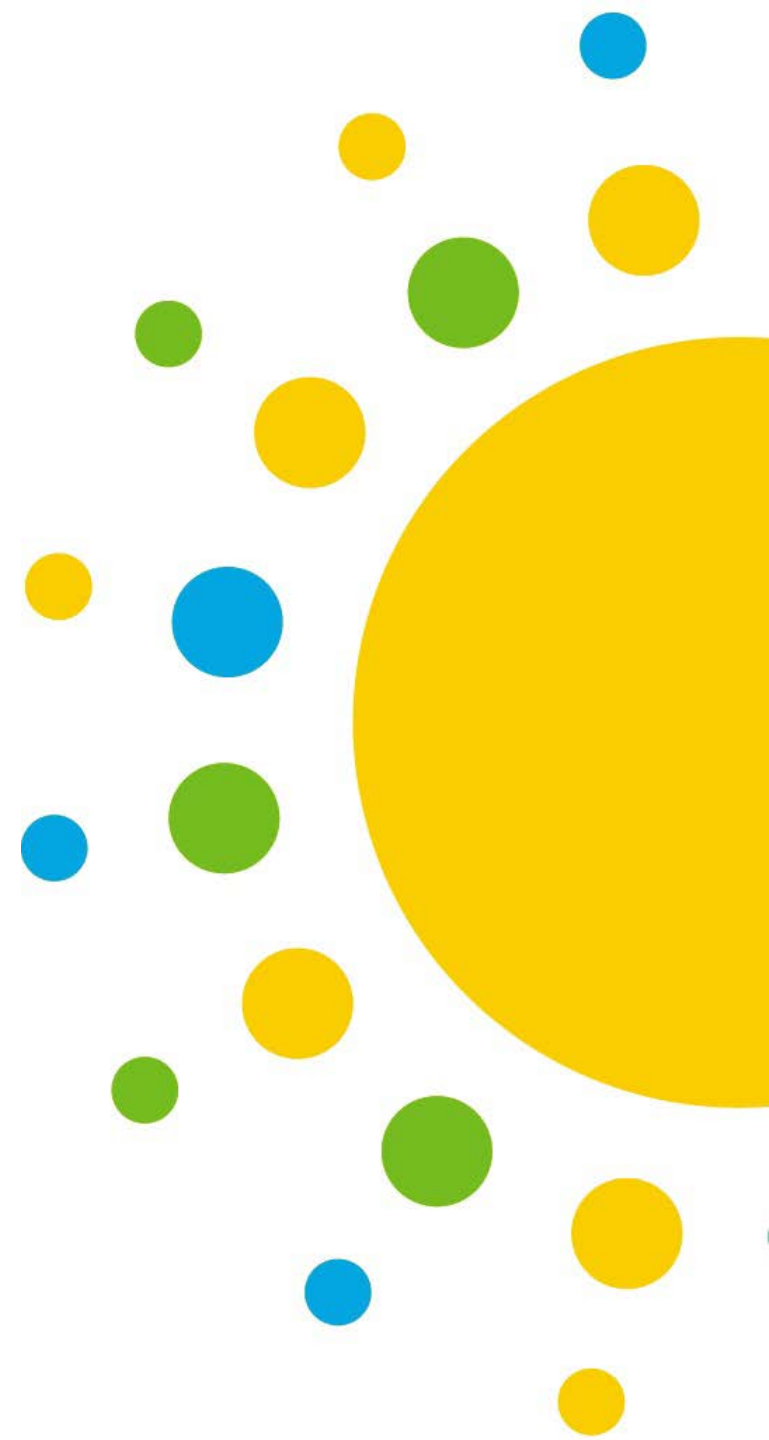


Thank you

www.energy.gov/communitiesLEAP

Produced for the U.S. Department of Energy
by the National Renewable Energy Laboratory (NREL).
DOE/GO-102024-6369 • August 2024

Additional Resources



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