



THE CITY OF PHILADELPHIA  
— OFFICE OF —  
SUSTAINABILITY

# POWERING OUR FUTURE: A CLEAN ENERGY VISION FOR PHILADELPHIA





## Letter from the Mayor

Dear Friends,

In *Greenworks: A Vision for a Sustainable Philadelphia*, my administration set forth a vision for our city where all Philadelphians efficiently use clean energy that they can afford. Using less energy and getting it from cleaner sources is critical to facing the challenges of climate change, which is already bringing wetter and hotter weather to Philadelphia. But moving towards clean energy has other benefits, such as creating local jobs, lowering utility bills, and improving air quality for all Philadelphians.

This work has become all the more critical in the wake of the Trump Administration's decision to withdraw from the Paris Climate Agreement and proposal to rescind the Clean Power Plan. Without leadership from the federal government, cities, residents, and businesses are continuing the important work of reducing the carbon pollution warming our planet. That's why I've pledged to meet a 100 percent clean energy goal as part of Philadelphia's long-term commitment to reduce citywide carbon emissions 80 percent by 2050.

*Powering Our Future: A Clean Energy Vision for Philadelphia* is a roadmap for our city that highlights opportunities for all Philadelphians to contribute to and benefit from a clean, affordable, and efficient energy future by reducing carbon emissions from our buildings and industry. While the Vision does not set a prescribed path to meet this future, we must take action across each of the focus areas in this report to meet our energy and climate goals.

To lead by example, my administration has already issued a Municipal Energy Master Plan that outlines how the City will better manage our own assets (including buildings and street lighting) while reducing energy use and greenhouse gas emissions. The Office of Transportation and Infrastructure Systems is also embarking on a transportation plan with climate change as a key consideration.

Turning this vision to reality will require action from every one of us. I look forward to working together to move Philadelphia toward a clean, affordable, and healthy energy future.

Sincerely,

Mayor Jim Kenney



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DRAFT

ON THE COVER: CHILDREN LEARNING ABOUT ENERGY EFFICIENCY AT THE SCIENCE CARNIVAL. PHOTO: LEANNE HARVEY | GRAPHIC DESIGN: WFGD STUDIO



# A Clean Energy Vision for Philadelphia

## WHY AN ENERGY VISION?

Energy is at the center of our lives. We need energy for heating in the winter months and cooling in our increasingly sweltering summers. We need energy to transport our food and keep it fresh when it arrives, to power our subways, and keep our water clean. In an increasingly technology-driven world, energy is critical to our way of life.

But while all Philadelphians use energy, not all Philadelphians can easily afford its costs. For many residents, energy is the second-greatest household expense after mortgage or rent payments. Using energy more efficiently in our homes and transitioning away from burning fossil fuels to create energy will save money and reduce carbon pollution, which causes climate change. Because

our most vulnerable residents are disproportionately harmed by changes in our climate, the transition to a just energy system that is clean and affordable for all is critical to achieving an equitable Philadelphia.



City Hall at night. (Photo: LeAnne Harvey)

The Office of Sustainability (OOS) committed to long-term energy planning for Philadelphia as part of the update to Greenworks, our vision for a sustainable Philadelphia. Through Greenworks, the City has made considerable strides toward a cleaner and more efficient energy system, including:

- Managing the Energyworks loan program for residents and businesses to cut utility bills and improve the efficiency and comfort of their homes and offices;
- Requiring large privately-owned buildings to report and disclose their energy usage;
- Improving permitting for rooftop solar installation in Philadelphia, and;
- Leading by example by improving the efficiency of City-owned buildings, purchasing local renewable energy credits, and training staff on smart building operations.

Despite these gains, we must deepen our efforts to meet Philadelphia's energy goals. To understand what steps we must take to meet the challenges of climate change, OOS met with residents, community groups, and issue experts throughout 2017 to understand Philadelphians' priorities for the long-term future of our energy system and share analysis of progress towards the Greenworks vision that all Philadelphians efficiently use clean energy that they can afford.

Based on this outreach, OOS shifted its focus from a shorter-term energy plan to a long-term vision for a Philadelphia that achieves Mayor Kenney's goal of reducing carbon emissions 80 percent from 2006 levels by 2050 while emphasizing equity and health for all Philadelphians. *Powering Our Future: A Clean Energy Vision for Philadelphia* (CEV) is the result of this effort, but it's just the start of a citywide conversation about achieving our goals.

## WHAT'S IN THIS REPORT?

The CEV covers three major parts of Philadelphia's energy system: our city's 600,000 buildings, local industry, and the regional energy system that powers them. Taken together, these sectors account for nearly 80 percent of carbon emissions in Philadelphia, and transforming them will be critical to achieving a clean and just energy future.



The second-largest source of carbon emissions in Philadelphia is transportation. The Office of Transportation and Infrastructure Systems launched Connect: A Philadelphia Transportation Project in fall 2017 to begin long-term planning for the future of transportation, including climate, equity, and health considerations.

This report covers carbon emissions local to Philadelphia, but many of our actions contribute to climate change, from intercontinental travel to purchase of manufactured goods. OOS is partnering with the Urban Sustainability Directors' Network to learn more about emerging practices in measuring these impacts, and is committed to sharing those findings and potential actions in the future.

## Values

To transform Philadelphia's energy system to meet our city's long-term goals, OOS has identified five core values for future energy work:



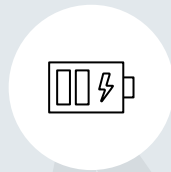
### **CLEAN:**

Energy used by Philadelphians reduces our contributions to climate change and local air pollution.



### **EFFICIENT:**

Philadelphians cut wasted energy, saving money and reducing pollution.



### **RESILIENT:**

Philadelphians continue to have access to energy even as climate change results in higher temperatures, increased precipitation, and more extreme weather.



### **AFFORDABLE:**

Changes to our energy system help reduce utility bills, particularly for vulnerable Philadelphians.



### **EQUITABLE:**

Our energy vision acknowledges historical and existing inequities in how the energy system impacts Philadelphians and works to eliminate those inequities.

## DEVELOPING THE CLEAN ENERGY VISION

OOS committed to energy planning as part of *Greenworks: A Vision for a Sustainable Philadelphia*, published in November 2016. OOS then contracted with a consultant, ICF, to develop a citywide energy model to help assess the current trajectory of energy usage and carbon emissions in Philadelphia and understand opportunities to move toward a cleaner and healthier energy future.

To gain public input on Philadelphia's energy future, OOS held several public stakeholder meetings in spring and summer 2017 and met with advocacy groups and issue experts. Among the key takeaways from this engagement were:

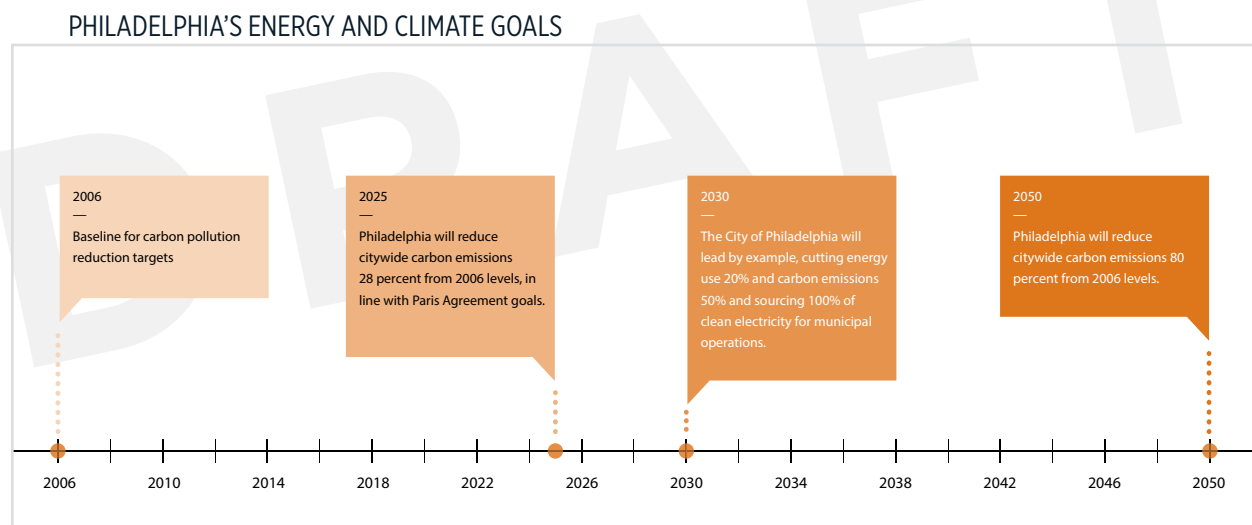


- **Stakeholder process:** Philadelphians are eager to be a part of determining how we work together to move toward our long-term energy goals.
- **Industry:** Participants in the meetings expressed concern over the climate and health impacts of legacy industrial infrastructure in Philadelphia, including the Philadelphia Energy Solutions refinery, and a desire to see the City address that infrastructure.
- **Co-benefits:** Participants also encouraged the City to continue to take a holistic view of energy and climate action, considering not just energy reductions and carbon savings but potential for job creation, air quality improvements, and transition toward a more equitable Philadelphia.

## PHILADELPHIA'S ENERGY AND CLIMATE GOALS

In the past two years, Mayor Kenney and the City of Philadelphia have set a series of ambitious targets to reduce carbon emissions and move our city toward a clean energy future:

FIGURE 1



Setting clear and measurable climate and energy goals is critical to successfully making the CEV a reality. However, meeting these goals alone will not achieve the Greenworks vision of a Philadelphia where all residents efficiently use clean energy that they can afford. To meet that challenge, we must also ensure that:

- We prioritize investments that reduce vulnerable residents' energy burdens (the percentage of income spent on utility bills) and improve indoor and outdoor air quality.
- Our energy system is resilient, providing heating, cooling, and other energy services to Philadelphians even as our climate changes.
- Philadelphia communities of color, which have not historically had access to sustainability opportunities and are most likely to be harmed by climate change, benefit from new programs and investments.
- The transition to a clean energy economy (see page 47) benefits all Philadelphians, creating employment opportunities for both for workers displaced through that transition and for those currently not able to access sustainable employment opportunities.



### Philadelphia Is Ready for 100

At the urging of Philadelphia residents in the wake of the Trump Administration's decision to withdraw from the Paris Agreement, Mayor Kenney and the City of Philadelphia became the 100th city to sign the Sierra Club's **Ready for 100** pledge on June 21, 2017.

The pledge commits cities to work toward a goal of 100 percent clean energy citywide. The CEV is our first step to meet this commitment.

Mayor Kenney signing on to Sierra Club's Ready for 100% Clean Energy Campaign  
(Photo: Samantha Madera)

## HOW WE'LL GET THERE

Meeting Philadelphia's energy and carbon reduction goals will require work across all levels of government and throughout our community. OOS has grouped this work into five categories:

- **Clean Electricity Supply (PAGE 16):** Philadelphia's electricity is generated by power plants not only in Pennsylvania but from a regional grid stretching from New Jersey and Delaware to West Virginia and Ohio. To achieve our goal of reducing carbon emissions 80 percent by 2050, the power plants in our regional grid must shift from reliance on coal and natural gas toward zero-carbon generation sources.
- **Citywide Solar (PAGE 23):** As part of the transition toward a cleaner grid, Philadelphians can do our part by installing solar generation on rooftops and other surfaces throughout the city. Like energy efficiency, this strategy can save residents money while spurring economic growth and moving us toward a clean energy future.
- **Energy-Efficient Homes and Businesses (PAGE 30):** The Environmental Protection Agency estimates that 30 percent of energy in an average commercial building is wasted. Eliminating this waste in our homes and businesses will save money, improve indoor air quality and tenant comfort, and reduce our reliance on fossil fuel-generated energy.
- **Low-Carbon Thermal Energy (PAGE 42):** Most buildings in Philadelphia are currently heated by oil, on-site gas furnaces, or the Veolia steam loop (which uses natural gas to generate heat and electricity). Emerging technologies like microgrids, high-efficiency heat pumps, fuel cells, geothermal and solar heating systems, and renewable bio-gas can reduce our reliance on fossil fuel energy for heating and domestic hot water.
- **Low-Carbon Economy (PAGE 47):** Factories, shipping, and refineries are a major source of carbon pollution within our city. By implementing the CEV, Philadelphia will create new clean economic opportunities for residents. OOS is committed to working with all stakeholders to understand how we can move together to achieve a just, healthy, and low-carbon economy that works for all our residents.



## WHAT'S NEXT

While many of Philadelphia's climate and energy goals are long term, we know there's work to be done now to move toward a clean and efficient energy future. The City of Philadelphia is committed to:

- **Leading by example:** The City of Philadelphia will demonstrate leadership in climate action by reducing energy consumption and carbon emissions from our own buildings through efficiency and renewable energy investment. The City is currently planning large-scale efficiency investments in the Philadelphia Museum of Art and many recreation centers and libraries through the City's Rebuild initiative. The City's Energy Office leads energy efforts for City-owned buildings and recently published the Municipal Energy Master Plan, which is available online at [www.phila.gov/green](http://www.phila.gov/green).
- **Further energy planning:** OOS and partners in local government are committed to continued planning on long-term energy challenges identified in the vision. The CEV will be updated as new technologies and policy strategies emerge, and the City will continue to participate in peer-learning networks like the Urban Sustainability Directors' Network, the C40 Exchange, and the Department of Energy's Better Communities Alliance to learn and share best practices with cities around the United States and the world.
- **Implementing programs and policies:** OOS will work with stakeholders and advocates to understand where there is collective interest in moving ahead with initiatives described throughout this document.

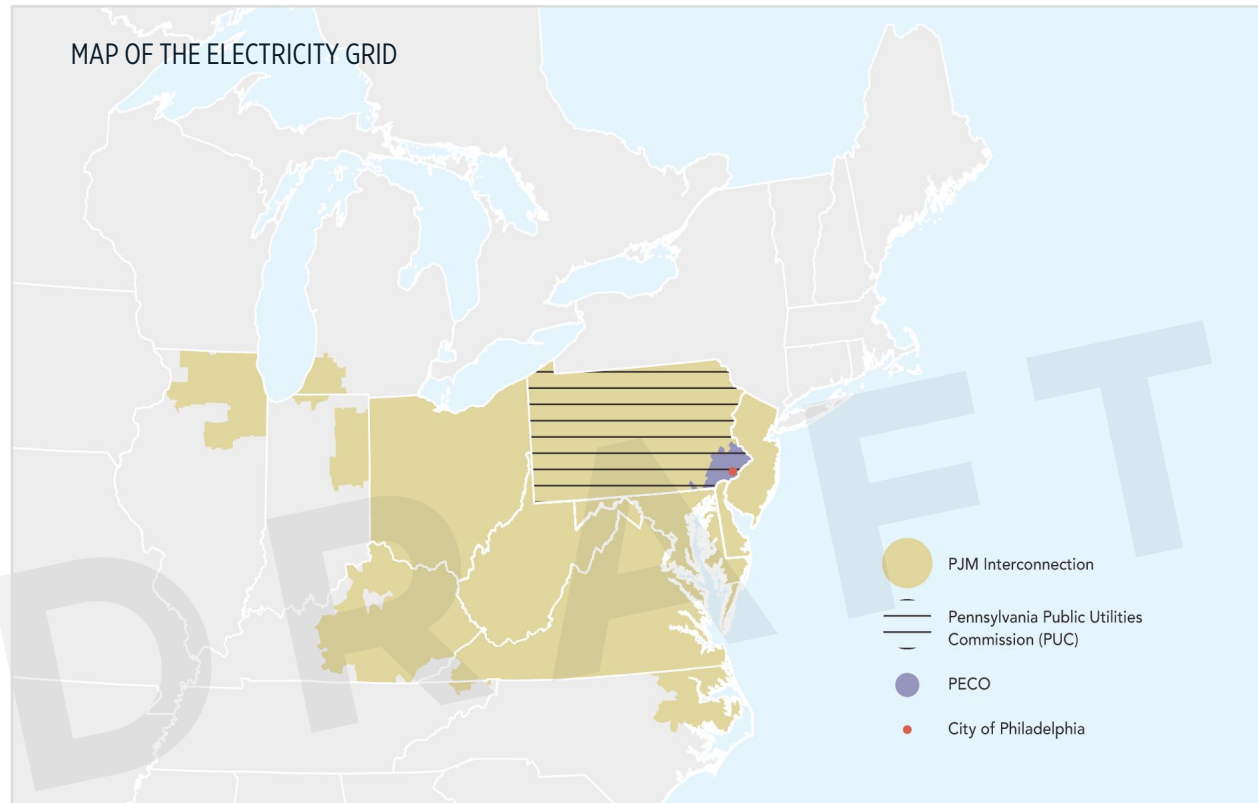
Achieving Philadelphia's energy vision will require action from all our residents and businesses, as well as politicians and regulatory agencies outside of Philadelphia. To learn more about how you can help achieve the clean energy vision, we've included sections on what you can do throughout this report. For more ideas, check out our Greenworks on the Ground guides and Environmental Action Guides, available online or in print by contacting the Office of Sustainability.





# How Philadelphia Homes and Businesses Get Energy

FIGURE 2

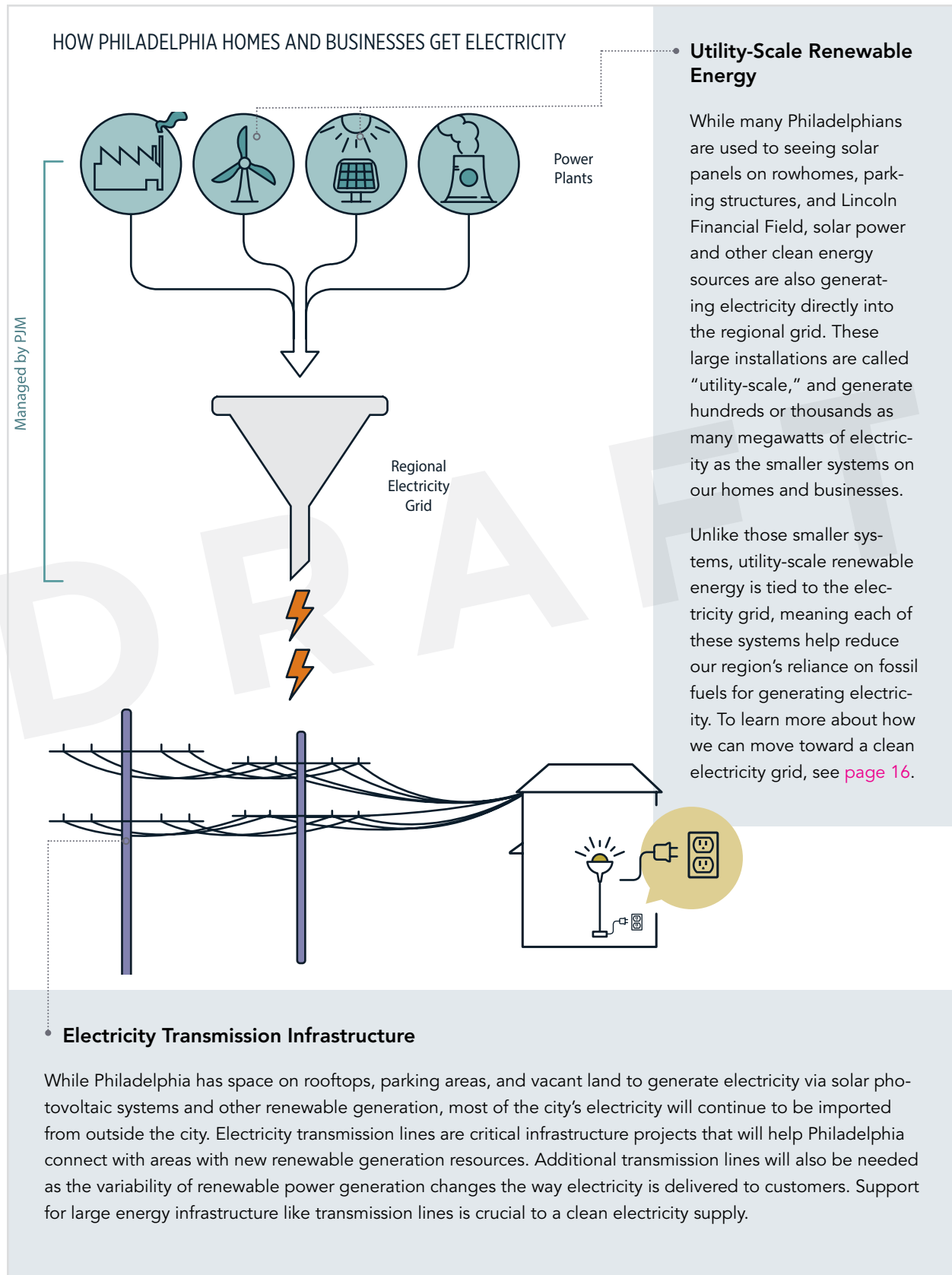


The electricity we use in Philadelphia is generated across the regional electricity grid, and several entities are collectively responsible for providing our electricity;

- **PJM Interconnection:** PJM operates the wholesale electricity marketplace, ensures reliability of the electricity grid, and conducts long-term planning for the future of electricity generation and transmission across 13 states and the District of Columbia.
- **Pennsylvania Public Utilities Commission (PUC):** Electricity is regulated at the state level by the PA PUC. The PUC sets rates (which influence how much your electricity costs) and manages programs to improve energy efficiency and promote renewable electricity.
- **PECO:** PECO is the distribution company in Philadelphia. While all customers can choose electricity suppliers through the PUC's PAPowerSwitch website, PECO is the only distributor for Philadelphia homes and businesses.
- **City of Philadelphia:** The City has a strong working relationship with PECO and regularly files comments on relevant proceedings with the PUC. The Office of Sustainability is reviewing opportunities to be more involved with PJM.



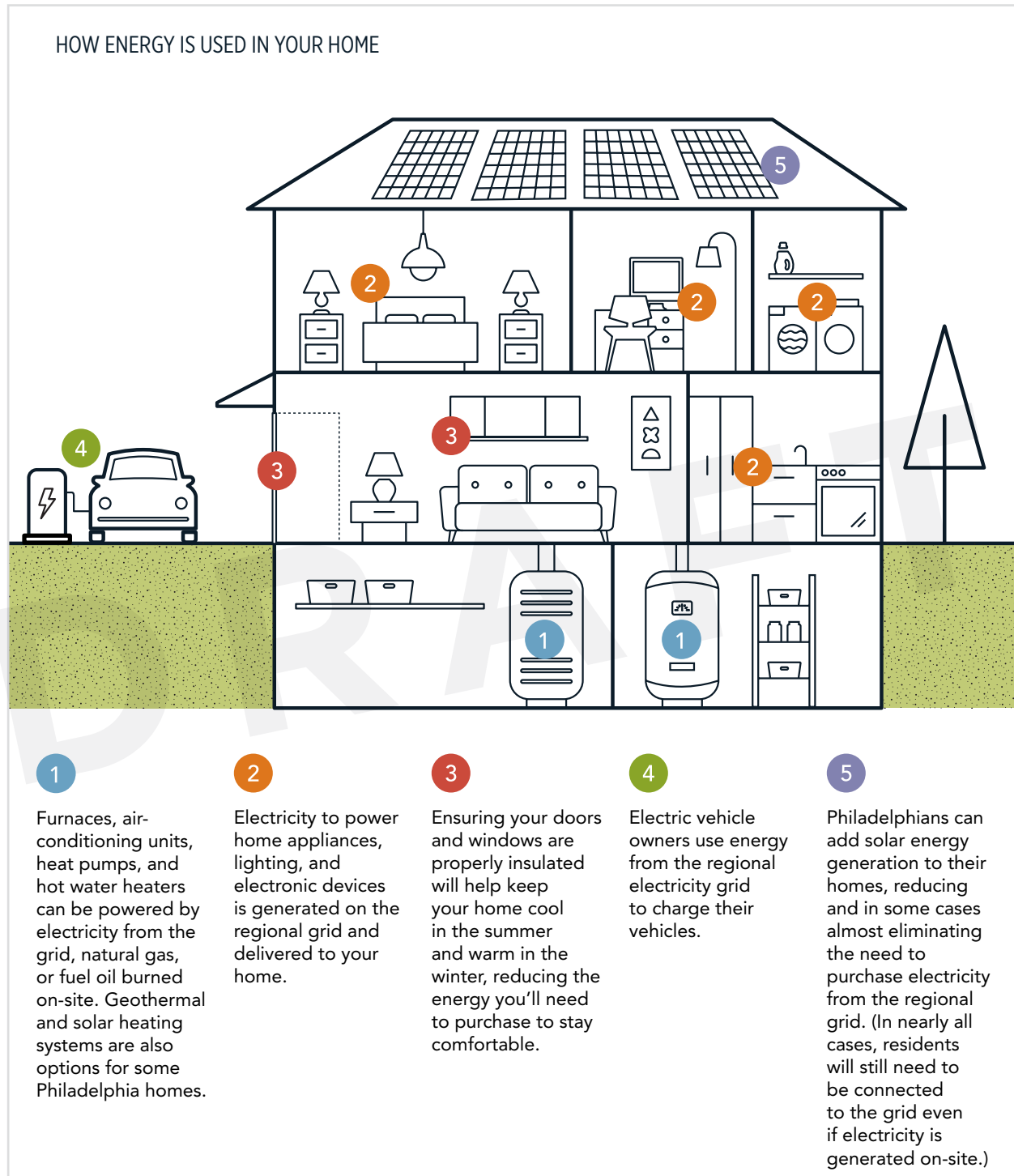
FIGURE 3



INTRODUCTION



FIGURE 4





# Climate Change and Energy

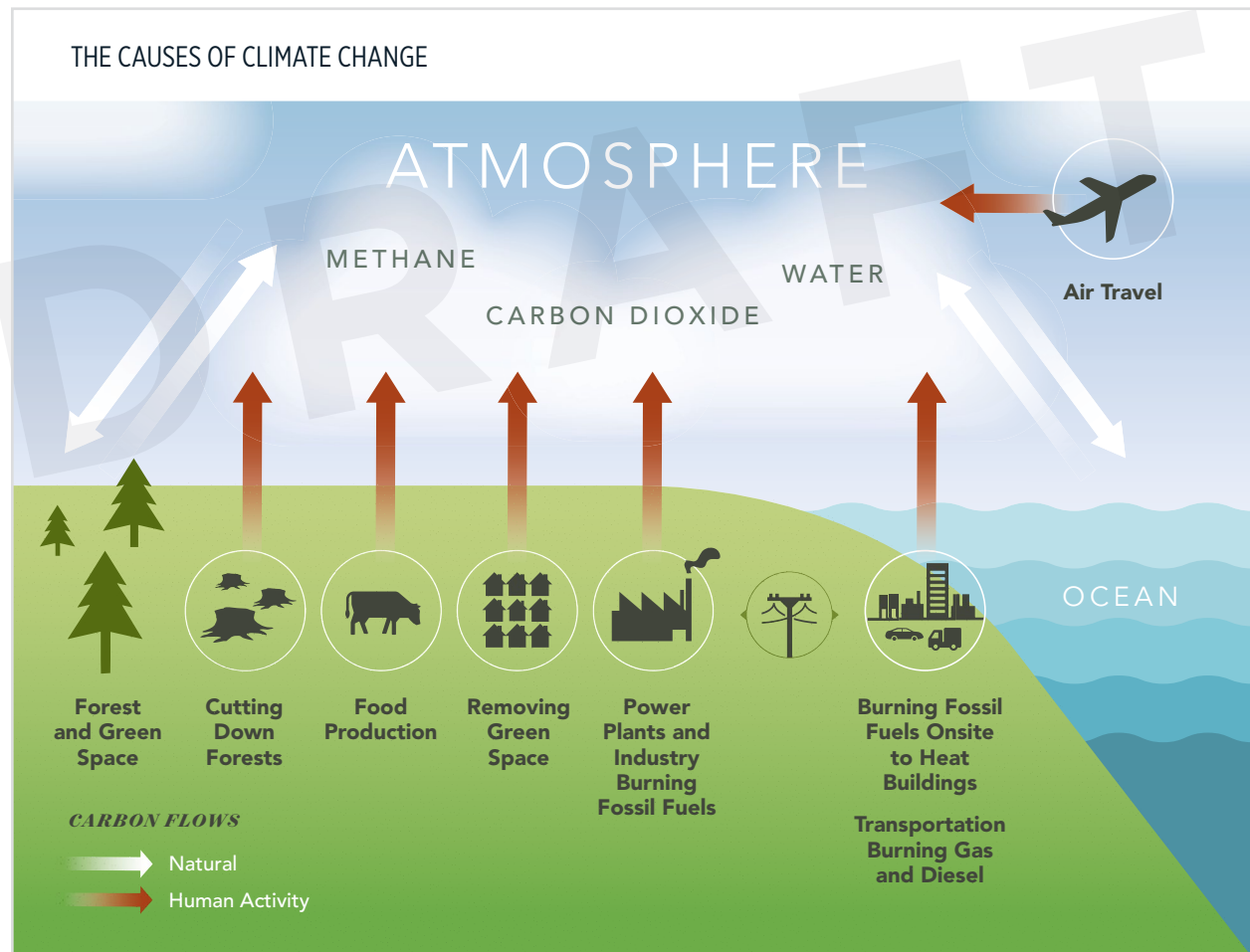
## WHY IS OUR CLIMATE CHANGING?

In the past, the natural carbon cycle kept our planet at a steady temperature.

Since the Industrial Revolution, humans have changed this cycle by burning fossil fuels (including coal, oil, natural gas, and gasoline) at a rapid rate, releasing more carbon dioxide (CO<sub>2</sub>) into the atmosphere than natural systems can handle.

This excess carbon dioxide (along with other “greenhouse” gases like methane and chlorofluorocarbons) in our atmosphere acts like a blanket, trapping heat on Earth, leading to higher temperatures, melting ice, and rising seas.

FIGURE 5



Human activity in Philadelphia and worldwide has altered the natural carbon cycle, warming the planet.

INTRODUCTION



## WHAT WILL CLIMATE CHANGE MEAN FOR PHILADELPHIA?

Climate change is a global challenge, but our warming planet will bring distinct changes to different parts of the Earth. In Philadelphia, climate change will have two major impacts: hotter temperatures and more precipitation.

Philadelphians are already accustomed to our sticky, humid summers, but climate change will make the worst of these days more frequent. In an average summer during the 1900s, we experienced four days above 95 degrees. By 2100, we could face as many as 52 days above 95 degrees, with many of those days coming in multi-day heat waves.

A changing climate will also make precipitation more common and heavier in Philadelphia in all four seasons. This means that although temperatures will be warmer on average, Philadelphia will still see heavy snowfalls in the winters to come.

Global climate change will have other local effects. Melting ice caps will bring higher riverfronts, which will worsen flooding along the Schuylkill and Delaware Rivers. Climate change will also make extreme storms more common, meaning more events like Hurricanes Irene and Sandy in all seasons.

## HOW IS THE CITY PREPARING FOR THE IMPACTS OF CLIMATE CHANGE?

The Office of Sustainability (OOS) worked with scientists to use global models to assess how the climate will change in the Philadelphia region. This analysis is summarized in the Useful Climate Information for Philadelphia report.

The scientists' models considered scenarios where we slow the burning of fossil fuels and others where we continue to emit carbon at a similar rate to the past. If we take climate action now, we can reduce future harm from climate change in Philadelphia. That's why climate action is a core value of *Greenworks: A Vision for a Sustainable Philadelphia* and this report.

But we know that even if we reduce carbon pollution, Philadelphia's climate will still change. In fact, we're experiencing the impacts of climate change in our city already. To ensure the City continues to provide essential services to residents as the climate changes, a Climate Adaptation Working Group made up of many City departments released *Growing Stronger: Toward a Climate-Ready Philadelphia*, which details actions city government can take to adapt to the changing climate.

## HOW DOES CLIMATE FIT INTO THE CLEAN ENERGY VISION?

Philadelphia's local carbon emissions contribute to the global challenge of climate change. The energy used by our buildings and industry account for 80 percent of those local emissions, and each of the efforts described on the following pages will help reduce local carbon emissions.

The strategies described on the following pages can also help address climate changes Philadelphia residents are already experiencing. Building a more resilient energy system will ensure our critical buildings (like hospitals, shelters, and public safety facilities) can continue to operate in emergencies. Moving toward a clean and efficient energy system can also help residents save money and preserve housing affordability, improving individual resilience to the extreme weather events climate change makes more likely.



## What Do Philadelphians Think about Energy?

Throughout 2017 Philadelphian residents have weighed in on their hopes and concerns for the future of our city's energy system.

### Clean Energy Vision Outreach

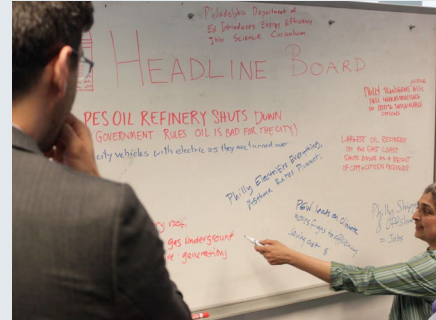
The Office of Sustainability (OOS) heard from hundreds of residents through a series of listening and engagement sessions and an online survey. Though this represents just a fraction of the voices in our city, these engaged residents helped guide the process toward creating Powering Our Future and challenged OOS to deepen community engagement around energy issues in 2018 and beyond.

### Philadelphia Resident Survey

OOS also participated in the 2016-17 Philadelphia Resident Survey, asking participants whether they had worked to make their homes energy efficient and if they struggled to pay utility bills. Nearly half of weighted survey participants have made their homes more energy efficient, but nearly a third have difficulty with energy costs, underscoring the need to ensure affordability in our energy system.

### What's Up Next

Powering Our Future is being released as a public draft to solicit additional feedback from residents, issue experts, and advocates. One local advocacy group, Philly Thrive, has already surveyed some residents on their vision for Philadelphia's energy future, and OOS will incorporate these results and other feedback into the final version of this report. You can complete a survey on Powering Our Future by visiting [www.phila.gov/green](http://www.phila.gov/green) or connect with us directly by emailing [sustainability@phila.gov](mailto:sustainability@phila.gov).



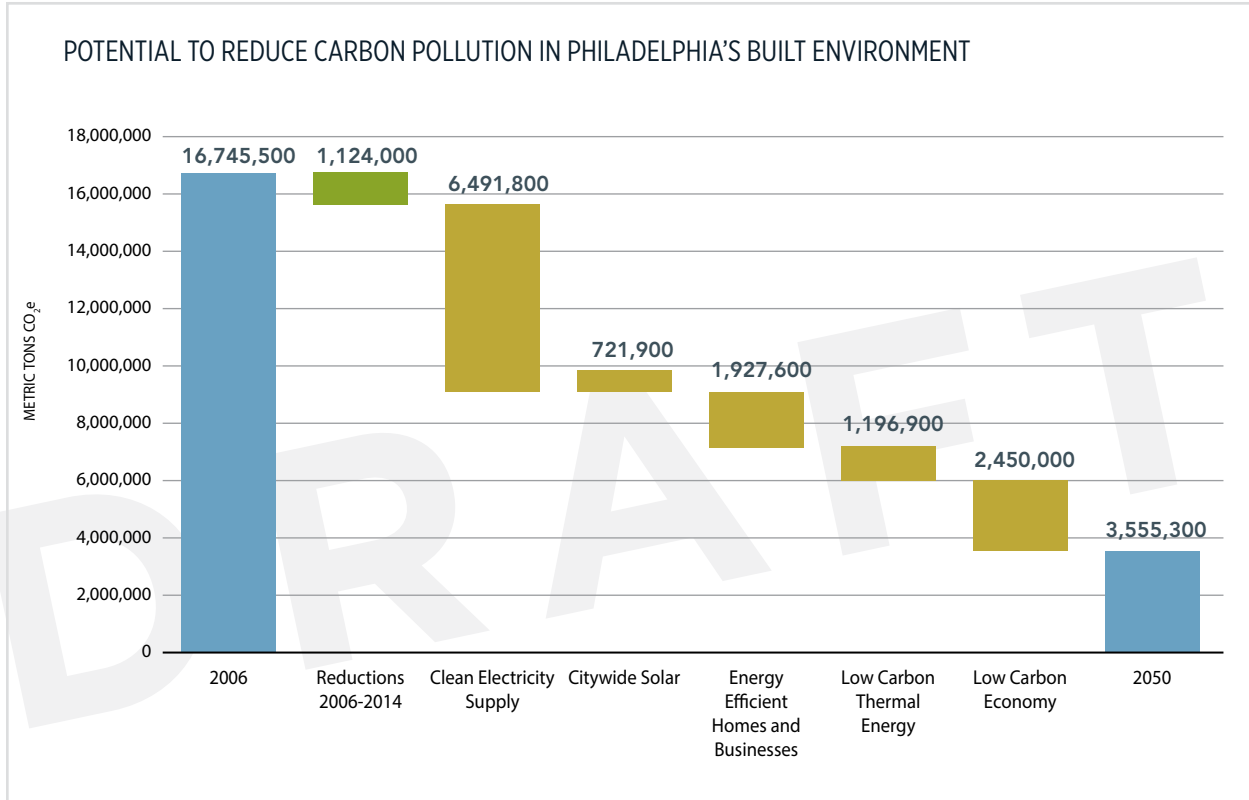
At one CEV engagement event, participants imagined headlines reflecting the clean energy vision they hope to see for our city. (Photo: LeAnne Harvey)



# How Will We Achieve Our Clean Energy Vision?

Meeting Philadelphia’s energy and carbon reduction goals will require work across all levels of government and throughout our community. OOS has grouped this work into five categories: clean electricity supply, citywide solar, energy-efficient homes and businesses, low-carbon thermal energy, and low-carbon economy.

**FIGURE 6**



The GHG reduction potential of each of these strategies is interrelated: we will need to make greater efficiency investments if carbon emissions from electricity grid generation do not decline as quickly as modeled, and grid intensity similarly impacts the effectiveness of a transition to low-carbon thermal energy. Though shown as a separate set of strategies above, citywide solar is part of the transition to a clean electricity supply.

Achieving our clean energy vision will take significant effort by the City, residents and businesses, and others in Philadelphia and at the state and federal levels. The following pages describe each of the five categories in more detail and outline how Philadelphians can work together to achieve our clean energy vision.

INTRODUCTION



# Clean Electricity Supply

## WHERE WE'RE GOING

39 percent of Philadelphia's built environment carbon emissions come from electricity generated by fossil fuel-burning power plants throughout the region. By 2050 the electricity generators supplying our grid must be fossil fuel-free to meet Philadelphia's goal of reducing citywide emissions 80 percent from 2006 levels.

Cleaning our electricity supply is critical to reduce current carbon emissions, but it is also necessary for further climate action. Moving toward electricity for some thermal energy uses (see Low-Carbon Thermal Energy section) and electrifying both personal vehicles and large fleets like the City's and SEPTA's will add demand to the electricity grid, and could potentially increase carbon emissions if we don't meet our clean electricity goals.

Moving toward a clean supply will create other benefits. Construction and installation of new clean grid infrastructure can create new jobs for Philadelphians, particularly in the solar industry (see Citywide Solar section). And while most electricity generation happens outside of Philadelphia, eliminating the air pollution from fossil fuel-fired power plants, particularly those burning coal, elsewhere in Pennsylvania could lead to health benefits for Philadelphians.

The transition to a clean electricity supply must also consider Philadelphia residents who are already struggling to pay utility bills. This transition can reduce those bills in the long term (particularly when paired with energy efficiency and local solar generation opportunities), but must also work to avoid price spikes as older coal and gas plants are retired.

Because the electricity grid is regional (see page 9), the City of Philadelphia and our residents and businesses cannot clean the grid on our own. To meet our goals we'll need to advocate for a clean grid in Harrisburg and Washington, encouraging our elected representatives to build on the state Alternative Energy Portfolio Standard, and preserve the proposed Clean Power Plan to ensure a shift to a clean grid that benefits all Philadelphians.

CLEAN ELECTRICITY SUPPLY

### Co-Benefits

#### EQUITY

A smart transition to a clean grid will maintain or even lower energy costs for low-income residents.

#### HEALTH

A clean grid will improve regional air quality, reducing incidences of asthma and other respiratory illnesses.

#### ENVIRONMENTAL

Eliminating the burning of fossil fuels in the regional grid will reduce the need to extract those fuels, improving the health of rivers and other natural systems.

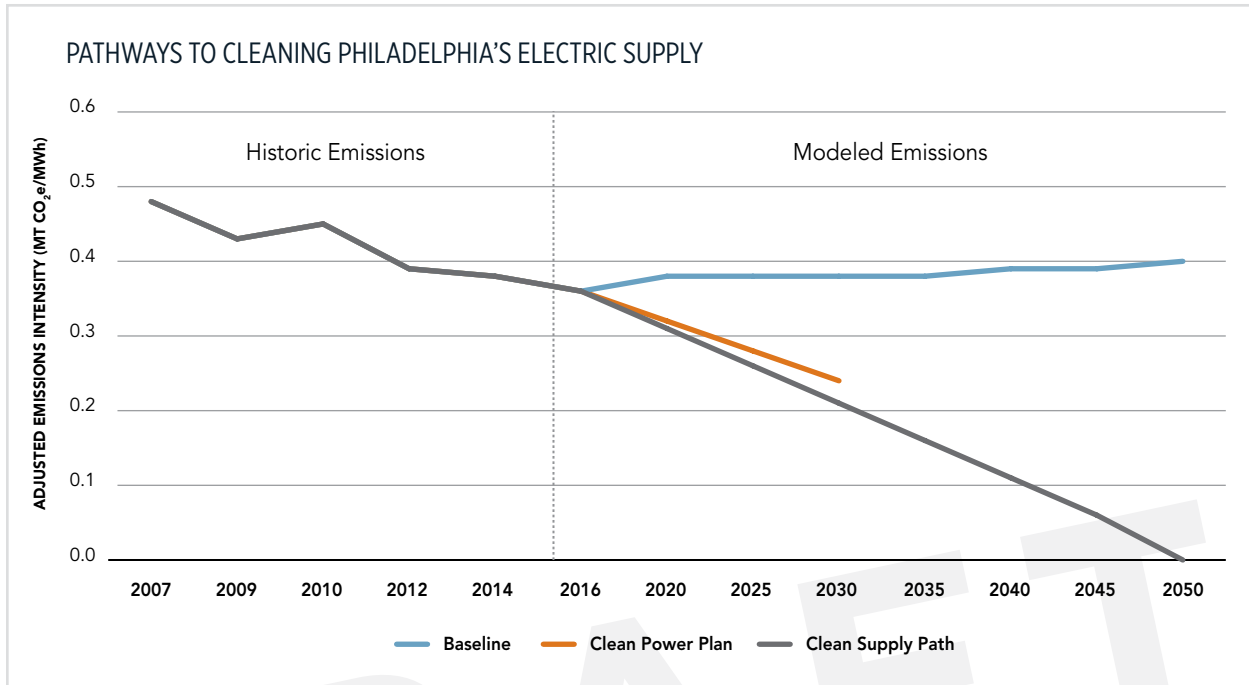
#### ECONOMIC

The clean grid transition will be a massive economic opportunity, particularly because key renewable electricity resources like solar and wind can be generated at smaller-scale, distributed locations.





FIGURE 7



To meet the clean electricity supply goals necessary to achieve our clean energy vision, Philadelphians should continue to advocate for the implementation of the Clean Power Plan or another strategy to reduce carbon pollution from existing power plants in our regional electricity grid (see page 22).

## HOW WE'LL GET THERE

OOS evaluated current electricity grid trends (see Figure 7) and projections of the future grid developed by the Energy Information Agency, both with and without the implementation of the Clean Power Plan.

Because the electricity grid is regional, eliminating fossil fuel generation will require a combination of market forces and actions across all levels of government, including at the federal level.

The Clean Grid Playbook on the following pages evaluates both short- and long-term opportunities to use existing mechanisms to move the grid away from fossil fuel generation and toward a clean energy future.

### Current Progress Toward A Clean Grid

Moving our regional electricity grid away from fossil fuel generation will be incredibly challenging, but there are positive signs this transition is already underway.

Since 2007, the carbon intensity of the grid has declined more than 26 percent. While this is largely due electricity generation switching from coal to natural gas—itsself a fossil fuel—this transition demonstrates the grid is capable of rapid and dramatic change in response to market signals.

There is also tremendous opportunity for renewable energy generation in our grid region. Western Pennsylvania's hills and proximity to major metros make wind economically viable there. And while solar generation has been slow to ramp up in Pennsylvania due to state policies and historic market conditions, the results of the City's recent Request for Information from the Energy Office and the success of the Solarize Philly program indicate the solar market is strengthening.



## WHAT YOU CAN DO

- **Choose clean energy for your home or business:** Through the Public Utility Commission's [PAPowerSwitch.com](http://PAPowerSwitch.com) website, you can select your electricity supplier, including companies offering 100 percent clean energy generated within the Commonwealth of Pennsylvania. Make the switch at home, and encourage your employer to also commit to purchasing clean, local energy.
- **Local, state, and federal advocacy opportunities:** Achieving a carbon-free grid will require action across all levels of government. Let your elected officials know a clean electricity grid is a priority, and see the Playbook on the following pages for specific advocacy opportunities.
- **Consider local renewable generation:** Investing in solar energy in your home or business reduces carbon emissions on the grid and helps move Philadelphia toward a clean energy future.

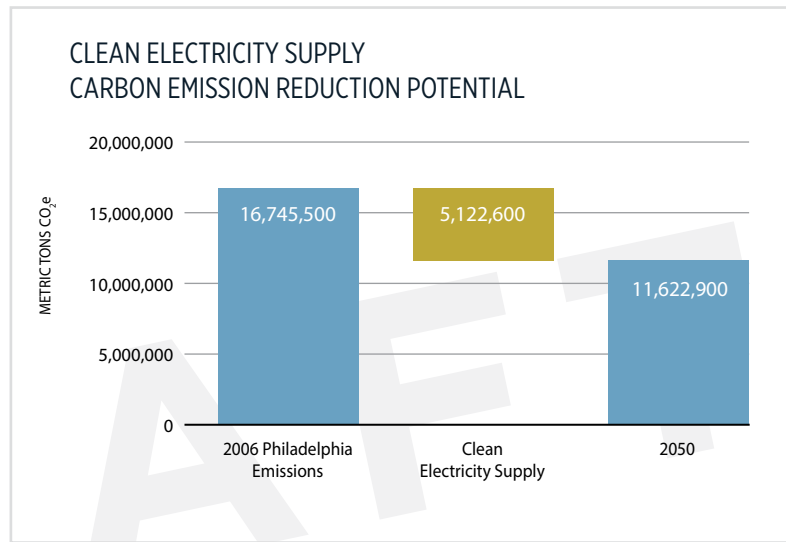


# Clean Electricity Supply Playbook

The Clean Electricity Supply Playbook evaluates both short- and long-term opportunities to use existing mechanisms to move the grid away from fossil fuel generation and toward a clean energy future. These strategies are split into local, state, and federal opportunities. Implementing these strategies will require buy-in from multiple stakeholders, who are identified in the Key Players boxes.

Even without further action at the local or federal levels, eliminating carbon pollution from our electricity supply would dramatically reduce our local impacts on global climate change. Cleaning electricity supply is also critical for effectively achieving other strategies to fight climate change, including running Philadelphia's cars and buses on electricity.

**FIGURE 8**



CLEAN ELECTRICITY SUPPLY

LOCAL RENEWABLE ENERGY PURCHASING	20
City of Philadelphia Renewable Purchasing	
Institutional Renewable Power Aggregation	
PA Power Switch and Community Choice Aggregation	
STATE AND FEDERAL ADVOCACY	21
Strengthening Alternative Energy Portfolio Standard	
Joining the Regional Greenhouse Gas Initiative	
Protecting the Clean Power Plan	
LOCAL RENEWABLE ENERGY GENERATION	22



### KEY PLAYERS

*City of Philadelphia Renewable Purchasing*

**Philadelphia City Council:**

Must approve Power Purchase Agreement.

**Energy Office and Philadelphia Energy Authority (PEA):**

**Energy Office** will manage project for the City, and **PEA** will hold long-term contract.

**Renewable energy developers:** Develop, finance, install, and maintain renewable energy project.

### KEY PLAYERS

*Institutional Renewable Power Aggregation*

**Large Institutions:** Pool energy purchasing to develop a renewable energy project within the regional electricity grid.

**City of Philadelphia:** Convene institutional partners and lead effort to collectively develop renewable energy project.

### KEY PLAYERS

*PA Power Switch and Community Choice Aggregation*

**Pennsylvania Public Utilities Commission:** Implements PA Power Switch program.

**City of Philadelphia and community partners:** Educate residents and businesses about opportunities to purchase clean energy.

## LOCAL RENEWABLE ENERGY PURCHASING

Nearly all the electricity used by Philadelphians is generated outside the city, giving residents, businesses, and institutions a considerable opportunity to influence the grid through electricity purchasing decisions.

### City of Philadelphia Renewable Purchasing

Since 2012 the City of Philadelphia has purchased local renewable energy credits to help meet Greenworks sustainability goals and drive the local renewable energy market. Improving market conditions in Pennsylvania and interest from the City and stakeholders has led the Office of Sustainability's Energy Office to evaluate more direct opportunities to spur renewable energy development, including a renewable energy power purchase agreement (PPA).

Under the PPA model, a renewable energy developer would develop, finance, install, operate, and maintain a renewable energy project. Power produced at the project would be fed into the electricity grid and purchased by the City. The third party would own the solar array or renewable energy generation asset, but the City would own the renewable energy credits and the zero-emission electricity produced.

The City issued a Request for Proposals (RFP) for a renewable energy PPA in October 2017, which will help the City decide what percentage of its electricity purchase can be affordably purchased through a PPA in the short term. If the PPA model successfully meets the City's environmental and economic goals, the City will consider additional PPAs to directly purchase more clean electricity.

### Institutional Renewable Power Aggregation

The City of Philadelphia's electricity buying power is significant, but could be bolstered by collectively developing a renewable power purchasing strategy with other large institutions within Philadelphia.

Independently or in cooperation with the City, large institutions (including businesses, universities and colleges, quasi-governmental agencies, and large non-profits) could collectively seek proposals for a large renewable energy development to off-set their electricity usage. The project would provide cost stability for the institutions while also helping to clean the regional electricity supply.

### PA Power Switch and Community Choice Aggregation

Currently, any Philadelphia resident or business paying an electricity bill through PECO can choose an electricity supplier with 100 percent renewable electricity through the Pennsylvania Public Utility Commission's [PAPowerSwitch.com](http://PAPowerSwitch.com) website.

As of July 2017, 34 percent of residential customers in the PECO territory (which includes Philadelphia) have switched their electricity supplier, though the PUC does not publish data on what percentage of those have switched to 100 percent renewable suppliers.<sup>1</sup> The City of Philadelphia will increase education

<sup>1</sup> <http://www.papowerswitch.com/sites/default/files/PAPowerSwitch-Stats.pdf>



efforts to inform residents and businesses of the opportunity to contribute toward a clean electricity grid.

To further leverage the collective buying power of city residents, many jurisdictions around the United States are implementing Community Choice Aggregation programs, where municipalities act as a collective energy purchaser, buying clean energy on behalf of its residents. In the most effective iterations of these programs, new electricity accounts are defaulted into the CCA, and must opt out to purchase electricity elsewhere on the market.

The Commonwealth of Pennsylvania's Public Utilities Commission currently prohibits opt-out CCAs. Changing this rule would enable the City of Philadelphia to explore creating a CCA and help residents move toward clean and affordable grid electricity.

## STATE AND FEDERAL ADVOCACY

Renewable energy purchasing is a key strategy toward a cleaner grid, but even if every dollar spent on electricity in Philadelphia went to clean energy generation, our regional electricity supply would still not be carbon-free. To meet that goal, we must work beyond city limits and advocate for policies at the state and federal levels that influence our transition to a clean electricity generation.

### Strengthening Alternative Energy Portfolio Standard

Pennsylvania's Alternative Energy Portfolio Standard (AEPS), Act 213 of 2004, requires 18 percent of the electricity supplied by Pennsylvania's electric distribution companies and electric generation suppliers to come from alternative energy resources by 2021. The AEPS further requires these entities to generate the equivalent of .5 percent of that electricity from solar energy systems, or offset .5 percent of their generation with solar renewable energy credits (SRECs).

In November 2017 Governor Wolf signed an update to the Administrative Code, modifying the AEPS to require SREC purchases to come from solar generation within the Commonwealth of Pennsylvania. This change should increase the value of solar development statewide, helping spur further solar development in the regional electricity grid.

The Commonwealth of Pennsylvania could further strengthen the AEPS to help move toward a cleaner grid in three ways:

- Extend the AEPS beyond the current 2021 program end date.
- Increase the total requirement for alternative energy purchasing within the AEPS above 18%.
- Increase the percentage of the AEPS that must be achieved through solar generation or SREC purchases above .5%.

### Joining the Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) is a program of nine Northeastern states to reduce carbon emissions from fossil fuel-fired power plants through a regional market for greenhouse gas permits. RGGI auctions allowances for carbon emissions which are then traded on the market, and proceeds from the auctions are used to fund energy efficiency and clean energy programming across the nine states.

The Commonwealth of Pennsylvania has been an observer since RGGI's launch in 2006, but has thus far declined to join RGGI as a participating state. Joining RGGI could be a significant financial benefit to Pennsylvanians: the state's 2014 CO<sub>2</sub> emissions of over 100 million tons could generate \$300 million or more in new funds based on recent RGGI auction prices. This is more than the \$217 million currently spent on energy efficiency through the Act 129 mandate alone. (See page 38 for more details on Act 129.)

#### KEY PLAYERS

*Strengthening Alternative Energy Portfolio Standard*

**PA Legislature:** Responsible for legislation to strengthen AEPS.

#### KEY PLAYERS

*Joining the Regional Greenhouse Gas Initiative*

**PA Governor's Office and Legislature:** Bring Pennsylvania into multi-state RGGI pact.



Governor Wolf has indicated support for Pennsylvania joining RGGI, but action from the Pennsylvania Legislature would be required to achieve this goal.

### Protecting the Clean Power Plan

The Environmental Protection Agency proposed the Clean Power Plan (CPP) in 2015 to limit carbon pollution from power plants in the United States. CPP instructs each state to create a strategy to improve the efficiency of existing fossil fuel-fired power plants so that by 2030 carbon pollution from the power sector will be between 24 and 33 percent below 2005 levels.

In addition to reducing our carbon footprint, the CPP would provide other benefits to Philadelphians and residents and businesses across the United States. Fossil fuel-fired power plants, particularly coal-burning plants, are among the greatest contributors to poor air quality in the United States, and the CPP would curb particulate matter pollution that can lead to asthma and other health hazards. The CPP would also spur job growth in the retrofitting of existing power plants and in the renewable energy and energy efficiency sectors.

Implementation of the CPP is currently on hold until federal courts affirm that it is legal. On October 10, 2017, the Trump Administration's Environmental Protection Agency (EPA) announced the proposed rollback of the CPP. This rollback will be subject to a public comment period. In the notice of the proposed rollback, the EPA indicated that a future announcement on another mechanism to reduce carbon emissions, as currently required by law, is forthcoming.

The City of Philadelphia has joined litigation to protect the CPP and will continue to make the case of the value of the proposed regulations. Residents and businesses can also contact elected officials to express their support for the CPP.

## LOCAL RENEWABLE ENERGY GENERATION

Philadelphia's constrained geography and high land values have made most large-scale local renewable energy generation proposals economically challenging. Successful advocacy around the AEPS, Clean Power Plan, or RGGI would change market economics and make expansion of existing renewable generation or new opportunities possible.

Given these factors, the most feasible renewable electricity generation for Philadelphia is currently solar power, which is covered on the following pages. The City will continue to monitor emerging technologies around wind, hydroelectric, and biomass generation opportunities and update this section as new opportunities emerge.

### KEY PLAYERS

*Protecting the Clean Power Plan*

**U.S. Environmental Protection Agency:** Responsible for reducing carbon pollution nationwide.



# Citywide Solar

## WHERE WE'RE GOING

By 2050 80 percent of the Philadelphia rooftop space currently suitable for solar generation (39 percent of total rooftops) will be producing clean electricity for residents and businesses.

Philadelphia will also take advantage of solar generation opportunities in other parts of the city, including on vacant parcels and on parking lots (a strategy already successful at Lincoln Financial Field). These solar installations could be privately-owned large-scale projects or neighborhood-serving community solar.

Meeting this vision citywide would represent a significant increase from the current pace of solar installation in Philadelphia (see Figure 9). While generating all of Philadelphia's electricity needs within city boundaries isn't possible with current technology, citywide solar will make a significant contribution to our clean grid vision while providing utility bill stability for Philadelphia residents and generate local job opportunities.

As described in the Municipal Energy Master Plan, the City will continue to lead by example, building on its existing solar installation at the Water Department's Southeast Water Pollution Control Plant. The City is building on this success by studying opportunities for further solar generation on municipal rooftops and other City-owned spaces.

### Co-Benefits

#### EQUITY

As solar generation becomes more affordable, it will become easier to add to Philadelphia homes in every neighborhood to lower energy bills and provide clean power.

#### HEALTH

Citywide solar will help displace fossil fuel generation from our regional electricity grid, reducing air pollution making its way into Philadelphia.

#### ENVIRONMENTAL

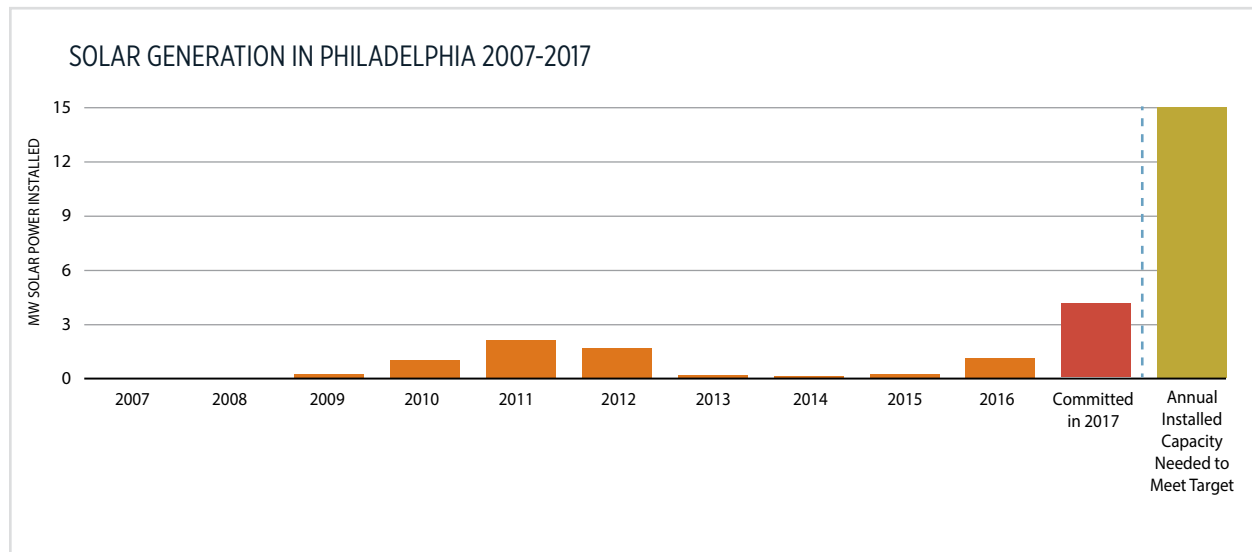
Providing renewable electricity to Philadelphians is one of the most effective mechanisms for combatting climate change.

#### ECONOMIC

Installing solar generation citywide will generate new local job opportunities.

CITYWIDE SOLAR

FIGURE 9



Thanks to large-scale initiatives by SEPTA (3.1 MW), the Philadelphia Navy Yard (.44 MW), and the collective investment of Solarize Philly (.89 MW), 2017 solar commitments if completed would be the biggest year ever for new generation. However, even this impressive effort must be scaled up to meet current solar potential (see page 25).



## HOW WE'LL GET THERE

Meeting a citywide solar goal will require a commitment by the City and by businesses, large institutions, and residents. In the past year, new commitments by SEPTA to invest in solar generation on their property and the success of the Philadelphia Energy Authority's Solarize Philly program demonstrate the potential for this leadership, but more work must be done to ensure solar power is available to all Philadelphians, including low-income residents.

While solar is a smart investment for many Philadelphians today, new technology and business opportunities may create even more affordable solar generation in the years to come. The City will continue to monitor these changes to technology and update citywide solar modeling as Philadelphia's capacity to generate clean electricity increases.

## WHAT YOU CAN DO

- **Evaluate the solar potential of your home or business:** Solarize Philly helped hundreds of Philadelphia residents evaluate whether solar generation was right for their households. Residents and businesses can also work with solar installers directly; the Delaware Valley Green Building Council maintains a contractor database to help find an installer right for you at [www.dvgbc.org](http://www.dvgbc.org).
- **Invest in energy efficiency:** By cutting energy waste in your home or business, you can not only save money and cut carbon pollution, the energy you save can also make installing solar panels to generate your electricity needs more cost-effective.
- **Advocate for favorable solar policies at the local, state, and federal levels:** Many local advocacy groups work at the local, state, and federal levels to support policies to help make solar panels accessible to all Philadelphians. You can find a list of these groups through the City's Environmental Action Guide: <http://bit.ly/philaactionguide>

### Success Story: Solarize Philly

In 2017 the Philadelphia Energy Authority (PEA) launched Solarize Philly, a group buying program designed to help Philadelphians go solar at home. As with other Solarize models, the more customers who sign contracts, the deeper the discounts for all participants. The program built in revenue streams to expand job training programs and to offer an affordable option for low- and moderate-income households.

More than 2,100 Philadelphia households expressed interest in Solarize Philly during the first phase of the program. By November 2017, 186 households signed solar installation contracts, which will result in 885 kW of new solar capacity within the City of Philadelphia. PEA plans to reopen Solarize Philly for enrollment in 2018.

As part of PEA's mission to expand access to clean energy for all Philadelphians, PEA will launch a Solar for All program for low- and moderate-income homeowners in early 2018. Visit [www.solarizephilly.org](http://www.solarizephilly.org) for details.



PEA partnered with the School District of Philadelphia to pilot a solar training program for high school students in the summer of 2017. Solar States, a Philadelphia-based solar installer, taught the "Find Your Power" course. The class equipped 18 Philadelphia students to pursue careers as solar installers. PEA and the District plan to offer new solar training for high school students and adults in 2018. (Source: Solar States)





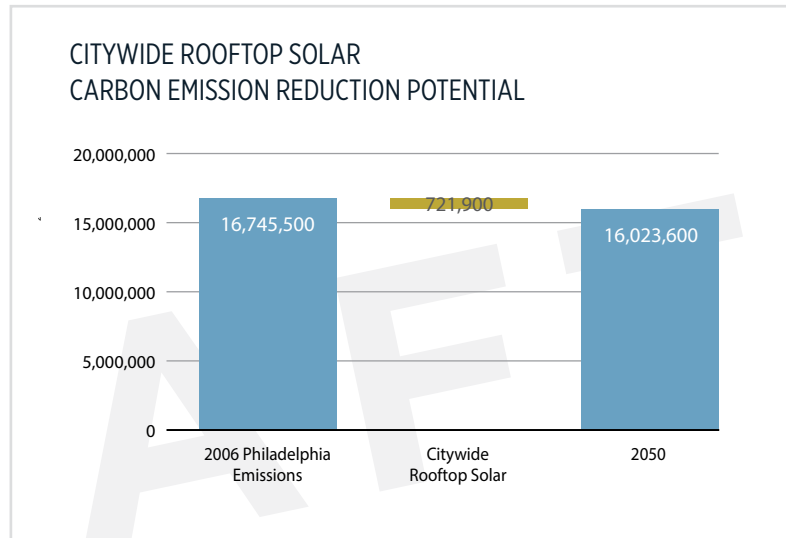
# Citywide Solar Playbook

As with strategies to clean our regional electricity supply, three types of efforts can promote solar in Philadelphia: local actions by City government and our partners, statewide advocacy to help grow the solar installation market and decrease the cost of solar installation in Pennsylvania, and federal advocacy around renewable energy policy.

Achieving our citywide solar vision will require buy-in from multiple stakeholders, who are identified in the Key Players boxes on the following pages.

OOS modeled the installation of solar generation on 80 percent of Philadelphia’s rooftop space currently feasible for solar. This would create considerable economic opportunities but only limited carbon pollution reductions with current technology. The City will continue to monitor new technologies and opportunities and update citywide solar modeling as Philadelphia’s capacity to generate clean electricity increases.

**FIGURE 10**



CITYWIDE SOLAR

<b>LOCAL ACTION</b>	26
Addressing Soft Cost Barriers	
Citywide Solar Installation Campaigns	
Solar in New Construction and Renovations	
Leverage Home Repair and Weatherization Programs	
Lead by Example	
<b>STATE ACTION</b>	28
Update Alternative Energy Portfolio Standard	
Re-establish PA Sunshine Program	
Statewide Policy and Planning	
Enable Community Solar Projects in Philadelphia	
<b>FEDERAL ACTION</b>	29



## LOCAL ACTION

### Addressing Soft Cost Barriers

Since 2011 the Office of Sustainability (OOS) and the Department of Licenses and Inspections (L+I) have worked together to reduce “soft costs” associated with developing solar projects in Philadelphia (the time and effort that goes into installing solar panels, including permitting, zoning, interconnection, financing, customer acquisition, and installation).

In 2012 OOS worked with City Council to pass legislation that significantly reduced the cost of solar permitting by excluding the costs of panels and inverters from calculations.

In 2016 OOS and L+I updated the expedited solar permit standard, giving small solar projects for one- and two-family dwellings that are 10 kW or less in size the following benefits:

- Proceed with only an electrical permit (no building permit required)
- Expedited permit processing time (within five days) for qualifying permit applications

In 2017 Philadelphia became a SolSmart Gold designated community in recognition of efforts to make it faster, easier, and cheaper to install solar energy. Through discussions with solar installers and the statewide Finding PA’s Solar Future initiative, the City continues to work with the local solar community to identify new opportunities to further drive down soft costs and make solar available to all residents.

### Citywide Solar Installation Campaigns

Collective purchasing or “solarize” campaigns encourage solar adoption by bringing neighborhoods together to purchase solar panels in bulk, reducing the costs for everyone involved. Several solarize campaigns have been conducted in Philadelphia neighborhoods with successful results, including the Philadelphia Energy Authority (PEA)’s Solarize Philly campaign. Continuing and expanding these programs in the years ahead will ensure that solar power becomes more available for all Philadelphians.

### Solar in New Construction and Renovations

Through the City’s density bonus for LEED construction, developers already have some incentive to consider clean electricity generation when adding to Philadelphia’s skyline. Numerous other opportunities to incentivize or require new construction or major retrofits to responsibly manage their carbon footprints are addressed in the Energy Efficiency Playbook, and many of these strategies are also applicable to solar generation.

#### KEY PLAYERS

##### *Addressing Soft Cost Barriers*

**OOS and L+I:** Working with solar developers to identify and reduce barriers to developing solar projects in Philadelphia.

**Philadelphia City Council:** Approves some changes to permitting rules in Philadelphia.

#### KEY PLAYERS

##### *Citywide Solar Installation Campaigns*

**PEA:** Current implementer of the Solarize Philly campaign.

**Community and non-profit partners:** Leading solarize campaigns in other parts of the city and region.

#### KEY PLAYERS

##### *Solar in New Construction and Retrofits*

**Philadelphia City Council:** Pass legislation to offer incentives.

**Real estate developers:** Implement energy-saving measures in new construction and renovation to exceed existing energy code.

**City agencies:** Support developers in meeting building performance goals and verifying compliance.



#### KEY PLAYERS

##### *Leverage Home Repair and Weatherization Programs*

##### **City of Philadelphia and non-profit partners:**

Manages BSRP and other programs to improve condition of Philadelphia homes.

##### **Philadelphia City Council:**

Passed real estate transfer tax increase to fund new investment through BSRP.

#### KEY PLAYERS

##### *Lead by Example*

**Energy Office:** Managing research and development of opportunities to invest in clean energy on city-owned property in Philadelphia.

**Philadelphia Energy Authority:** Partner on energy projects that require long-term contracts.

### Leverage Home Repair and Weatherization Programs

Many Philadelphians may be interested in adding solar generation to their homes, but are unable to do so given the current condition of their roof or other basic systems. Through the Basic System Repair Program (BSRP) and other strategies, the City is working with residents to bring Philadelphia's aging housing stock up into good repair, which may enable more residents to take advantage of solar opportunities in the years ahead.

As the market for solar generation continues to improve, installing solar panels as part of these home repair programs may become possible. On-site solar generation would provide low-cost electricity to residents while also improving the comfort and safety of their homes.

### Lead by Example

The City of Philadelphia has already sought to lead by example by both purchasing clean energy and installing solar energy on-site. The City's Energy Office began purchasing renewable energy credits in 2012 and transitioning this purchase to local (Pennsylvania) credits in 2015. The Philadelphia Water Department installed a large solar array on its Southeast Water Pollution Control Plant, which currently generates 330,000 KWH of electricity annually.

To further this leadership, in November 2016 the City's Energy Office in partnership with the Philadelphia Energy Authority (PEA) released a Request for Information regarding project structures that would make renewable energy development feasible for the City. Examples of the types of projects the PEA and the City were seeking to understand further included: solar power on City facilities, off-site renewable power purchase agreements, and other alternative technology applications. Responses provided information on all three types of projects. The City is now seeking requests for proposal for an off-site PPA, as described on page 20.

The Energy Office is also working with the Office of Innovation and Technology to develop a solar potential map to assess Philadelphia rooftops. This map will help City departments understand their buildings' solar potential, and it will give an estimate of potential solar electricity production across all city rooftops. The City plans to make this map public so that homeowners and businesses can understand potential solar production for their properties as well.



## KEY PLAYERS

*State Action to Improve Local Market*

**PA Legislature:** Responsible for legislation to strengthen AEPS and to reauthorize the PA Sunshine Program.

**City of Philadelphia and statewide partners:** Working together to identify new opportunities to promote solar through statewide initiative.

## STATE ACTION

Throughout the nation, state level policy drives local solar markets, and Pennsylvania's solar industry has lagged in recent years due to inconsistent market signals from Harrisburg and an end to incentive programs. Solar currently produces less than one percent of Pennsylvania's net electricity generation. There are several opportunities for the state to lead on promoting solar generation in Pennsylvania.

### Improve Alternative Energy Portfolio Standard

Pennsylvania's Alternative Energy Portfolio Standard (AEPS), Act 213 of 2004, requires 18 percent of the electricity supplied by Pennsylvania's electric distribution companies and electric generation suppliers to come from alternative energy resources by 2021. The AEPS further requires these entities to generate the equivalent of .5 percent of that electricity from solar energy systems, or offset .5 percent of their generation with solar renewable energy credits (SRECs).

In November 2017 Governor Wolf signed an update to the Administrative Code, modifying the AEPS to require SREC purchases to come from solar generation within the Commonwealth of Pennsylvania. This change should increase the value of solar development statewide, helping spur further solar development in the regional electricity grid.

The Commonwealth of Pennsylvania could further strengthen the AEPS to help move toward a cleaner grid in three ways:

- Extend the AEPS beyond the current 2021 program end date.
- Increase the total requirement for alternative energy purchasing within the AEPS above 18%.
- Increase the percentage of the AEPS that must be achieved through solar generation or SREC purchases above .5%.

### Re-establish PA Sunshine Program

The Commonwealth of Pennsylvania can also offer direct incentives for solar development, as was the case under a previously robust rebate program. Launched in 2009 under Governor Rendell, the PA Sunshine Rebate program provided \$100 million in rebates for solar panels on homes and small businesses, but was not been funded since the Corbett Administration. The Wolf Administration has expressed interest in restarting this program, but funds have yet to be appropriated by the Pennsylvania Legislature.

### Statewide Policy and Planning

In 2016 the state launched Finding Pennsylvania's Solar Future to identify solar development and investment strategies to increase solar electricity generation within Pennsylvania. The program's initial objective is to increase the amount of in-state electricity sales that come from in-state solar energy generation to ten percent by 2030. The City is participating in this initiative in conjunction with community members, non-profit partners, and solar policy experts from across Pennsylvania.



### Enable Community Solar Projects in Philadelphia

While installing solar on the roofs of homes and businesses is a great option for many Philadelphians, residents in rental properties or those with inconvenient roof shading or orientation, structural roof issues, or insufficient space may not be candidates for rooftop solar. Shared renewable projects, also called community solar projects, provide a solution to those barriers. Community solar allows multiple participants to benefit directly from the energy produced by one solar array. Community solar participants typically benefit by owning or leasing a portion of a system, or by purchasing a portion of the renewable electricity generation.

Pennsylvania does not currently allow shared or community solar configurations. The closest allowed configuration is dictated by the state's virtual net metering (or meter aggregation) rules. Under the state's current rules, a customer that installs a renewable energy generation system can apply portions of the system's output to other electricity accounts owned by the same customer. The meters attached to the other accounts must be within two miles of the boundaries of the customer's host property and be in the same utility territory.

The major barrier to community solar currently in Pennsylvania is that multiple customers cannot share one electric meter. Alternative community solar models that do not require a shared meter include:

- **Utility-sponsored model:** A utility owns or operates a project that is open to voluntary ratepayer participation. Depending on how the utility sets up a program, it may require legislative and/or Public Utility Commission (PUC) approval.
- **Special Purpose Entity (SPE) model:** Individual investors join in a business enterprise to develop a community solar project.
- **Non-Profit model:** Donors contribute to a community installation owned by a charitable non-profit corporation. Under current law, donors with tax liabilities can deduction donations to the non-profit.

### FEDERAL ACTION

The combination of low electricity prices and limited state incentives can make economically justifying solar projects over the short-term challenging. But projects can still make economic sense if customers are comfortable with a longer-term investment. The federal government currently offers a 30 percent Solar Investment Tax Credit (ITC) which can help bring down costs.

Currently the ITC is scheduled to ramp down after 2019 and expire altogether by 2022. Ensuring that these incentives are renewed or replaced with a similar state program (like the PA Sunshine Program described above) would help scale solar installation in Philadelphia beyond the lifetime of the current ITC, providing cost-certainty for developers looking beyond 2019 for installation.

#### KEY PLAYERS

##### *Enable Community Solar Projects in Philadelphia*

**PA Legislature:** Responsible for legislation to enable community solar in Pennsylvania.

**PA Public Utilities Commission:** Regulates rules around community solar statewide.

#### KEY PLAYERS

##### *Federal Solar Incentives*

**U.S. Congress:** Responsible for passing legislation to extend or update the solar ITC.



# Energy-Efficient Homes and Businesses

## WHERE WE'RE GOING

Energy efficiency is the foundation of any strategy to meet Philadelphia's climate goals and move our city toward a more equitable energy future. The Environmental Protection Agency estimates as much as 30 percent of the energy in our buildings is "energy waste" and could be eliminated without reducing occupant comfort. By 2050 Philadelphia will have eliminated this waste through the actions of local and state government, individuals, and institutions.

Eliminating energy waste will save money for building owners and tenants and reduce reliance on fossil fuels for both electricity and on-site heating. By reducing the demand for energy in our buildings, energy efficiency makes meeting Philadelphia's electricity needs with adding solar generation cheaper and easier.

Every Philadelphian can save energy in our homes and businesses, and the City and other local institutions have a large role to play in helping them to do so.

To achieve our energy vision, we'll need to invest in the efficiency of both our largest buildings (where the greatest carbon savings can be achieved) and in Philadelphia's rowhomes. More efficient homes will save money for Philadelphians, including those facing high energy bills, improve indoor comfort, and create local job opportunities for our residents.

## HOW WE'LL GET THERE

The Office of Sustainability worked with energy experts to model the energy, climate, and health impacts of various energy efficiency policies at the state, local, and individual level. The Energy Efficiency Playbook on the following pages details the results of this modeling, outlines opportunities to improve the efficiency of our homes and businesses, and identifies key players that must be involved to achieve those efficiencies.

However, these actions alone will not meet Philadelphia's clean energy vision, and the City of Philadelphia is committed to measuring progress toward the vision while continuing to update this modeling as new efficiency opportunities emerge.

### Co-Benefits

#### EQUITY

Increasing efficiency of row-homes and apartments is part of a larger strategy to improve housing conditions for all Philadelphia residents.

#### HEALTH

Efficiency can increase tenant comfort and protect Philadelphians from extreme summer and winter weather.

#### ENVIRONMENTAL

Reducing energy usage in our homes and buildings is a necessary first step toward reducing Philadelphia's carbon footprint.

#### ECONOMIC

Energy efficiency improvements lead to energy cost savings for building occupants and create good, local job opportunities.



## WHAT YOU CAN DO

- **Take action at home:** Reducing energy waste as an individual is one of the easiest ways for Philadelphians to act on climate. See Page 32 for ideas on reducing home energy use, and check out Greenworks on the Ground for more opportunities.
- **Advocate for energy efficiency at work and in other spaces:** Do you know how efficient your school, business, or house of worship is? Most large buildings in Philadelphia disclose energy usage (see below), giving you the power to push for energy efficiency in your existing building or ensure energy is a consideration when choosing a new space to rent.
- **Local, state, and federal advocacy opportunities:** Achieving our energy vision will require action across all levels of government. Let your elected officials know energy efficiency is a priority, and see the Playbook on the following pages for specific advocacy opportunities.

### Success Story: Energy Benchmarking

The city's energy benchmarking program helps large building owners and managers in Philadelphia better understand their energy and water use.

In 2017 more than 2,800 buildings reported their energy and water use, representing more than 30 percent of the total citywide square footage. The median Energy Star score (a 1 to 100 scale where 100 is the best energy performer) for these buildings was 63, 13 points above the national average.

OOS shares this data back with building owners via the publicly available building energy data visualization tool (<http://visualization.phillybuildingbenchmarking.com>) and through custom report cards that highlight their performance relative to peers and provide tips on how to improve. To learn more, visit [www.phila.gov/benchmarking](http://www.phila.gov/benchmarking).

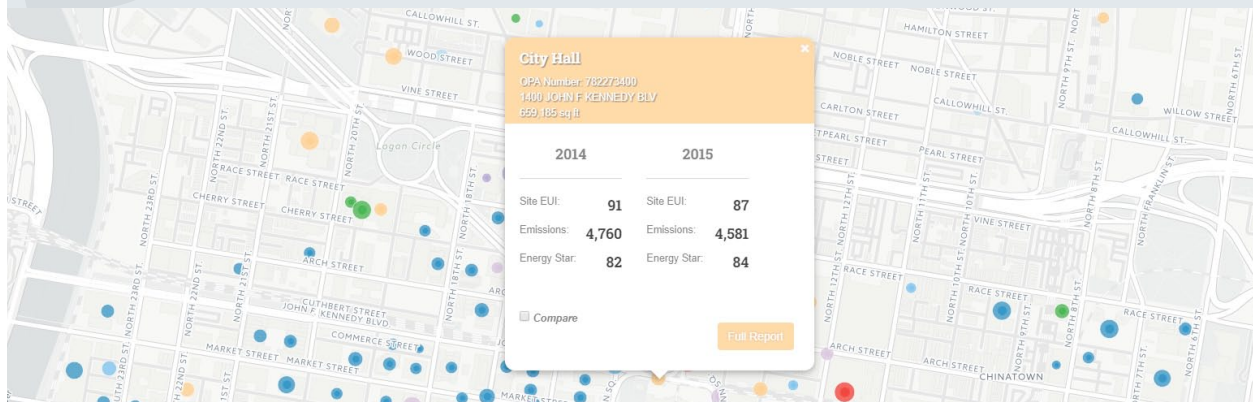
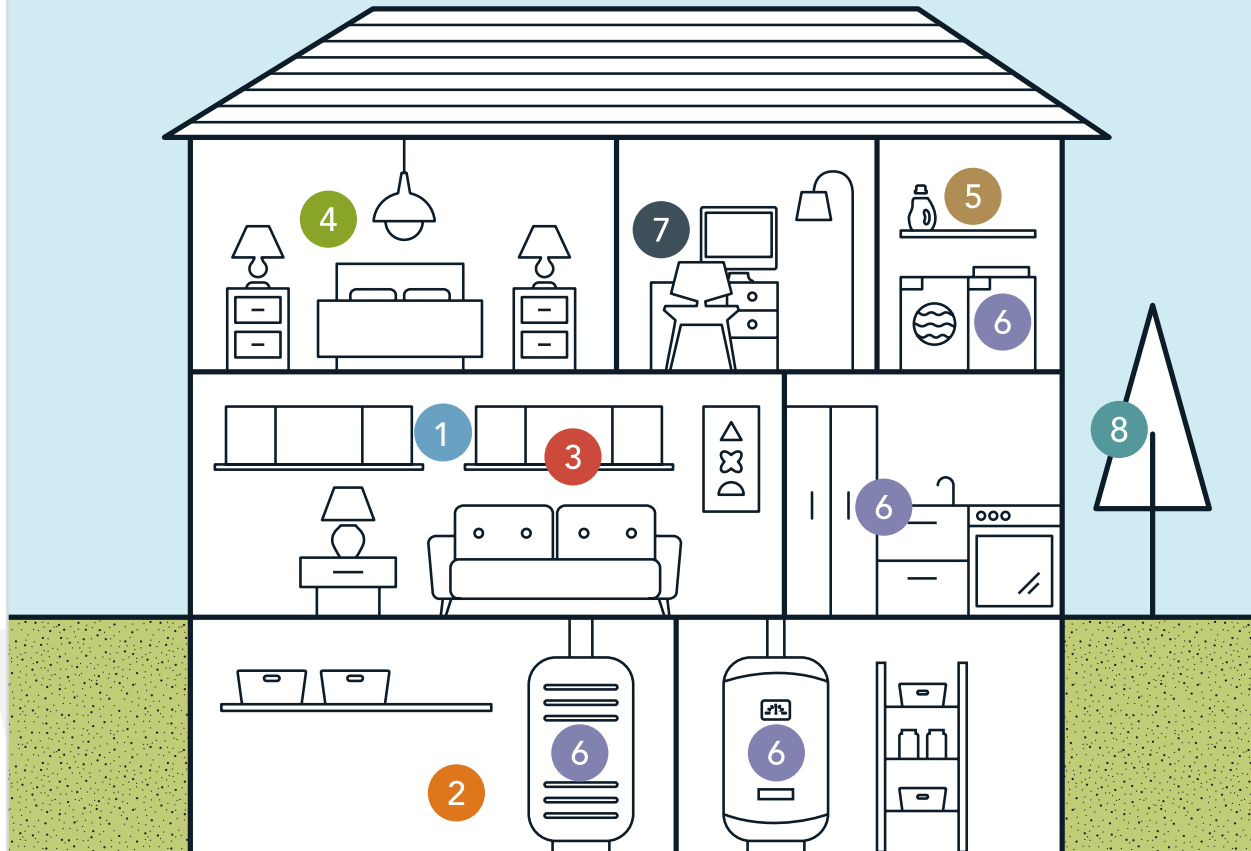




FIGURE 11

### Reducing Home Energy Use



- 1 Buy a **programmable thermostat** to reduce energy usage when you're away from home.
- 2 **Clean air filters** and **recharge coolant** to improve the efficiency of air conditioning.
- 3 Keep your **windows sealed** in the winter.
- 4 Use high-efficiency **ENERGY STAR**-labeled lightbulbs.
- 5 Wash your clothes in **cold water** and consider air-drying clothes on racks.
- 6 Check for **ENERGY STAR** label when replacing appliances and fixtures.
- 7 User **power management** features to improve efficiency of electronic devices and unplug any devices not in use.
- 8 Consider **planting trees** to provide shade in the summertime.



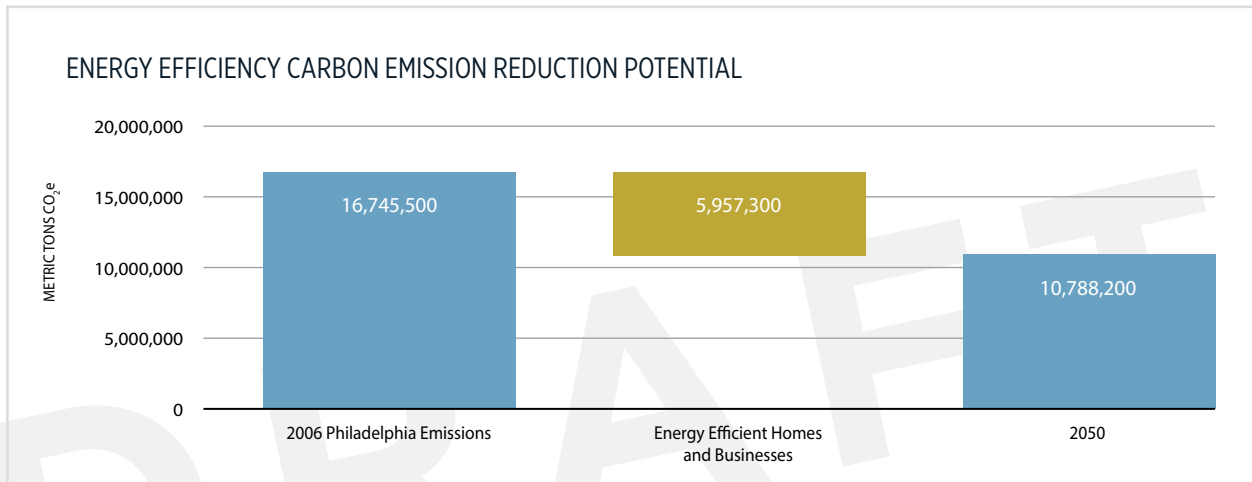


# Energy Efficiency Playbook

The Office of Sustainability modeled numerous strategies for improving the energy efficiency of buildings citywide. Residents and issue experts recommended many of these strategies as part of the CEV outreach process. Collectively implementing the energy efficiency playbook would result in significant carbon reductions citywide, as shown in Figure 12.

The following pages describe modeled energy efficiency strategies in detail. For information on modeling assumptions, see the appendix. Achieving these reductions will require buy-in from multiple stakeholders, who are identified in the Key Players boxes.

**FIGURE 12**



This chart indicates the potential carbon emissions reductions from implementing all the modeled strategies for cutting energy waste, assuming a business-as-usual electricity grid. If Philadelphia achieves our clean electricity supply goals, reductions from energy efficiency will be lower.

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Residential Energy Disclosure at Time-of-Sale	
Energy Conservation Requirements at Time-of-Sale	
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ENERGY EFFICIENCY



## KEY PLAYERS

### *Modernize Building Energy Codes*

**PA Legislature and Governor's Office:** State action required to modernize Pennsylvania's building code (or permit Philadelphia to adopt a more stringent code).

**Real Estate Developers, Homebuilders, and Contractors:** Must support update and implementation of modern building codes.

## BY THE NUMBERS

### *Commercial Energy Codes*

#### CARBON SAVINGS

186,830 MtCO<sub>2</sub>e

#### ANNUAL COST SAVINGS

\$51,304,207

## BY THE NUMBERS

### *Residential Energy Codes*

#### CARBON SAVINGS

103,290 MtCO<sub>2</sub>e

#### ANNUAL COST SAVINGS

\$27,140,667

## MODERNIZE BUILDING ENERGY CODES

Building energy codes are among the most effective policies to reduce building energy use over time. Even though new buildings typically account for a very small percentage of the building stock, over time they can have very strong impacts on energy use.

Current Pennsylvania law pre-empts the City of Philadelphia from unilaterally adopting codes other than those approved by the state. The potential impact of these strategies highlights the value of advocating for a change to those policies at the state level.

### Updating Commercial Energy Codes

The Commonwealth of Pennsylvania's building code for both commercial and residential buildings is currently based on 2009 standards. The IECC is updated every three years, with new code standards coming in 2018. The Pennsylvania Legislature recently passed House Bill 409 granting the City of Philadelphia a one-time opportunity to adopt the 2018 code standards for commercial construction.

To meet the energy code savings numbers modeled as part of the CEV, Philadelphia must adopt the 2018 codes and remain current every three years thereafter, as well as work with code officials to ensure future IECC standards continue to prioritize energy savings. OOS and Licenses + Inspections staff voted for efficiency measures as part of the 2018 IECC code update process, and expect to continue to advocate for these measures in future code cycles.

### Updating Residential Energy Codes

Modernizing residential codes will also be critical to achieve Philadelphia's climate and energy goals. New home construction and major renovations of existing row-homes are required to meet the IRC (International Residential Code), and increasing the baseline level of energy efficiency required in these projects can help reduce utility costs while moving us toward Philadelphia's clean energy vision.

## BUILDING CODE COMPLIANCE

While updating the energy code that Philadelphia builders must follow is currently a state issue, ensuring developers follow through with requirements must happen at the local level. To meet our climate and energy goals we must both modernize the energy code and ensure a high rate of code compliance for new development and renovations of existing buildings.

### Residential Energy Code Enforcement for Renovations and Additions

Given current resource constraints, energy codes are most actively enforced in new construction projects. However, any project that requires a City permit could be subject to energy code enforcement, including some residential renovations, additions, and alterations. Because existing-building improvements can account for a



**KEY PLAYERS**

*Building Code Compliance*

**Philadelphia Licenses + Inspections:** Agency responsible for code enforcement.

**Philadelphia City Council:** Approves L+I's code enforcement budget each fiscal year and passes laws for code compliance requirements.

**Building retrofit professionals:** Responsible for meeting code for renovations and additions.

**BY THE NUMBERS**

*Residential Energy Code Enforcement for Renovations and Additions*

**CARBON SAVINGS**  
9,290 MtCO<sub>2</sub>e

**ANNUAL COST SAVINGS**  
\$2,440,113

**BY THE NUMBERS**

*Third-Party Energy Code Compliance*

**CARBON SAVINGS**  
27,540 MtCO<sub>2</sub>e

**ANNUAL COST SAVINGS**  
\$7,237,511

**KEY PLAYERS**

*PACE Financing*

**Pennsylvania Legislature:** Must pass enabling legislation to permit PACE financing.

**Philadelphia City Council:** Would subsequently pass legislation to create PACE financing program.

large share of total built environment investment in each year, this strategy could significantly extend the energy savings impacts of energy codes.

Analysis by the Harvard Joint Center for Housing Studies indicates there are tens of thousands of projects in the city that may be covered by this strategy, which would require significantly more resources for the Department of Licenses + Inspections (L+I) to implement successfully.

**Third-Party Energy Code Compliance**

This strategy could allow consultants with energy rating expertise to assess code compliance for certain permitted projects (e.g. blower door testing of new residential construction). The 2015 and upcoming 2018 versions of the International Energy Conservation Code (IECC) contain an Energy Rating Index (ERI) compliance path, which enables accredited home energy rating providers to conduct code compliance analyses.

Permitting third-party compliance would engage experts who may be technically better equipped and have better capacity to conduct reviews and inspections than L+I, which is constrained by staff capacity.

**Required Energy Modeling and Disclosure for New Construction**

This strategy would connect building code compliance with the City's existing energy benchmarking program. Building projects meeting the benchmarking requirement would be required to use a simulation tool to project an energy use index and/or ENERGY STAR score for the building design. After a full year of operation, the buildings' actual benchmarked energy score would be compared to its projected score.

While energy modeling and disclosure itself will not directly lead to energy, carbon, and cost savings, data from that modeling can help assess the impact of other strategies within the CEV and provide information to potential tenants of new construction about the environmental impact of leasing opportunities.

**PACE FINANCING**

The property-assessed clean energy (PACE) model is a mechanism for financing energy efficiency and renewable energy improvements on private property. PACE programs allow local governments to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners. This allows property owners to engage in energy efficiency and renewable energy projects without taking on the full upfront costs. The property owner pays these funds back over time through property assessments, which are secured by the property itself and paid as an addition to the owners' property tax bills.

PACE financing is enabled through legislation in 33 states and the District of Columbia. The Pennsylvania Legislature is currently considering joining these states in permitting municipalities to create PACE programs for commercial buildings.

Depending on the final state legislation, the City of Philadelphia could offer



**KEY PLAYERS**

*2030 District*

**DVGBC:** Non-profit leading the creation of Philadelphia's 2030 District.

**Building owners and operators:** Volunteering to set energy reduction targets by joining District.

**City agencies:** Can encourage building owners to join District and provide support for energy savings initiatives.

**BY THE NUMBERS**

*2030 District*

**CARBON SAVINGS**  
525,560 MtCO<sub>2</sub>e

**ANNUAL COST SAVINGS**  
\$162,856,453

**KEY PLAYERS**

*Incentives for High-Performing Buildings*

**Philadelphia City Council:** Pass legislation to offer incentives.

**Real estate developers:** Implement energy-saving measures in new construction and renovation to exceed existing energy code.

**City agencies:** Support developers in meeting building performance goals and verifying compliance.

**2030 DISTRICT**

2030 Districts are geographically-defined, private-sector led partnerships that commit to reducing energy use 50 percent by 2030 from a 2003 baseline. 2030 goals also address water consumption and transportation carbon emissions. Stakeholders including property owners, managers, and local government work together to leverage financing and shared resources to reach voluntary reduction goals.

The Delaware Valley Green Building Council (DVGBC) launched the Philadelphia 2030 District in October 2017 with representation from major segments of Philadelphia's building stock in Center City and University City. By joining the District, building owners will have the opportunity to share best practices, access trainings and resources, and work together toward the District's ambitious shared climate goals.

The City of Philadelphia was among the first large real estate owners to join the 2030 District initiative, and can further support the program by encouraging businesses and institutions within the District to commit to meeting its energy, water, and transportation goals, and working with DVGBC and District participants to help meet goals and reduce barriers to achieving them.

**INCENTIVES FOR HIGH-PERFORMING BUILDINGS**

In addition to strengthening the required energy code for new construction, the City of Philadelphia can also incentivize real estate developers to go beyond code through a variety of mechanisms, including some that are already in place but could be further strengthened.

**Permit Streamlining**

Permit streamlining shortens the time to construction for projects that meet certain conditions. The City of Philadelphia has worked with solar developers to streamline permitting for renewable energy permitting, reducing the soft costs associated with permitting processes that may discourage installation and drive up the cost per kilowatt energy generated. This approach could be extended to new construction or major retrofits that commit to exceeding the required energy code (e.g. by committing to meeting LEED requirements or seeking an ENERGY STAR label upon completion).

**BY THE NUMBERS***Permit Streamlining***CARBON SAVINGS**155,660 MtCO<sub>2</sub>e**ANNUAL COST SAVINGS**

\$48,798,567

**BY THE NUMBERS***Density Bonus***CARBON SAVINGS**559,440 MtCO<sub>2</sub>e**ANNUAL COST SAVINGS**

\$158,667,619

**BY THE NUMBERS***Property Tax Incentives***CARBON SAVINGS**28,250 MtCO<sub>2</sub>e**ANNUAL COST SAVINGS**

\$8,753,754

Several jurisdictions, including the Commonwealth of Massachusetts and cities of Chicago and Seattle have some form of expedited permitting for development that meets sustainability and green building goals. Streamlining opportunities may be combined with other permitting incentives, such as reduced permitting fees, access to technical assistance, and “as-of-right” development. Streamlining can combine several related permits or set time frames for each step to be completed.

### Expand Density Bonus Incentive

Density bonuses offer developers an allowance to exceed existing zoning for taller buildings, more units or more floor space if the development provides a public benefit. The City of Philadelphia currently offers a density bonus for meeting LEED requirements and installing green roofs. To take further advantage of this opportunity, bonuses could also be awarded to projects that demonstrate they will exceed the required building energy code or provide other climate or energy benefits.

This strategy would require properties receiving density bonuses to achieve an ENERGY STAR score of 75 or higher or 70 percent reduction below national median for the property type within two years of occupancy (matching ENERGY STAR certification score requirement and 2030 District requirement for new construction and major renovations).

### Property Tax Incentives for High-Performing New Buildings<sup>9</sup>

The City of Philadelphia provides a ten-year tax abatement to all new construction and major renovation. Philadelphia City Council has considered various proposals to amend the abatement to meet the City’s long-term goals, which should include considerations of Philadelphia’s long-term energy and climate goals.

Multiple jurisdictions provide property tax abatements for efficient buildings. For example, Montgomery County, Maryland, provides tax exemptions of varying rates depending on the type of building and level of LEED certification. For this analysis, OOS evaluated the impact of incentivizing above-code construction for new construction and major renovation.

Providing a property tax incentive for high-performing buildings could be part of a larger strategy to reconsider the tax abatement. Council members and advocates have also proposed using the tax abatement as a tool to promote affordable housing and spur development outside of Center City, both of which could incorporate additional clean energy incentives.

### Municipal Impact Fees

To ensure compliance with the planning mechanisms described above, the City of Philadelphia could consider implementing an impact fee on all large new residential, new commercial, or certain renovation projects that do not meet specified requirements or fail to follow through with commitments during the development process. If projects do not meet these targets, the fees are withheld and are used to support public benefit initiatives such as energy efficiency programs.



In spring 2016 Miami Beach, Florida, became one of the first jurisdictions in the United States to implement an impact fee: new development that fails to meet green development standards will be required to pay a five percent fee on the cost of the project, with funding directed to programs to mitigate the impact of climate change on the coastal community.

**KEY PLAYERS**

*Utility-Funded Efficiency Opportunities*

**PECO and PGW:** Manage efficiency programming in Philadelphia.

**PUC:** Regulatory body authorizing Act 129 investment across Pennsylvania.

**City and residents:** Advocating for Act 129 programming benefitting Philadelphians.

**BY THE NUMBERS**

*Act 129 Opportunities*

**CARBON SAVINGS**  
573,910 MtCO<sub>2</sub>e

**ANNUAL COST SAVINGS**  
\$186,209,120

**KEY PLAYERS**

*Existing Building Requirements*

**Philadelphia City Council:** Must pass legislation for additional building requirements.

**OOS:** Implements existing benchmarking program.

**Local utilities:** Provides energy data building owners.

**Building owners and real estate community:** Must support new requirements.

**UTILITY-FUNDED EFFICIENCY OPPORTUNITIES**

In 2008, the Commonwealth of Pennsylvania passed Act 129, requiring investor-owned utilities to invest a percentage of their revenue in energy efficiency programming. PECO has since invested hundreds of millions of dollars in its service territory to improve the efficiency of homes and businesses, primarily through the Smart Ideas program. PGW voluntarily launched a similar program, Energysense, which provides a robust portfolio of market rate and low income usage reduction programs for residential, commercial and industrial customers.

Both Smart Ideas and Energysense provide rebates, incentives, and reduced costs for auditing services. The City and non-profit partners like the Energy Coordinating Agency work with the utilities to promote these efforts, which could be bolstered to supplement PECO and PGW's marketing and ensure that Philadelphians are maximizing the opportunity to save money and energy.

The City, key partners, and individuals and businesses should also continue lobbying for the next phase of Act 129 funding. The Pennsylvania Public Utilities Commission (PUC) will design future programs, set cost-effectiveness measurements, and authorize spending.

Both the City and residents can extend their roles advocating for Act 129 and future programs that benefit Philadelphia homes and businesses. Requests could include increased spending and programming designed to reach populations not currently benefitting from energy efficiency. Stakeholders interested in advocating for these changes can testify at public hearings, submit written comments, and participate in PUC working groups.

**EXISTING BUILDING REQUIREMENTS**

While the City of Philadelphia cannot currently increase the stringency of the building codes for new and existing buildings, the City does have authority to set other requirements for existing buildings, as was done with the creation of Philadelphia's energy benchmarking requirement. Additional existing building requirements could help building owners identify and implement energy savings opportunities in their homes and businesses.



### Expand Energy Benchmarking Program

Energy benchmarking and disclosure policies require owners of large buildings to report their energy usage annually, providing a basis for comparing performance among buildings and driving energy improvements over time. As one of the first cities to mandate energy benchmarking, Philadelphia completed its fifth year of data collection in 2017.

Philadelphia's benchmarking requirement was last amended in 2015, adding residential buildings 50,000 square feet and larger. This threshold is consistent with other jurisdictions, though some cities have required smaller buildings to report their energy usage.

Reducing the benchmarking threshold to 25,000 square feet would increase the number of properties required to report from 2,900 to more than 4,000. Many of these buildings would be smaller apartment buildings, which could provide valuable information both to the City and to potential tenants.

However, requiring additional buildings to report would increase the administration cost of the program to the Office of Sustainability and local utilities providing data. Further, OOS has found that buildings from 50-100,000 square feet are often under-resourced and thus less able to easily comply with the benchmarking requirement, and expect that buildings smaller than 50,000 square feet would be similarly challenged by the request without significant support from the City or a partner.

### Building Tune-up Program

Several jurisdictions across the country have introduced requirements that go beyond energy benchmarking to require the implementation of specific measures to improve energy performance. In Seattle, building owners will soon be required to perform building tune-ups (also called retro-commissioning), where a building professional will identify energy- and cost-saving measures that can be implemented immediately.

By optimizing building's controls and systems and maintenance, tune-ups can save building owners between 5 and 20 percent annually on energy costs, with a typical payback over a period of 6 months to 2.5 years. Tune-ups also provide detailed systems information for owners and operators, increased comfort for building occupants, and opportunities for skilled energy efficiency services jobs.

Unlike the energy benchmarking program, building owners would incur an estimated average cost of \$0.20 per square foot for building tune-ups. This may be burdensome to some building owners, particularly if the building is already high performing and has few tune-up opportunities. Like the expansion of the benchmarking program, a tune-up requirement would also require staff time from OOS or another implementing agency to help owners and operators understand the requirement and manage program compliance.

### Residential Energy Disclosure at Time of Sale

When you buy a home in Philadelphia, you receive a disclosure from the seller that covers the physical condition of the house. By adding a disclosure for energy performance (either through a rating system or through a direct sharing of recent utility bills), buyers would be better informed about the potential energy costs of their new homes, and sellers could be incentivized to improve the efficiency of a property before putting it on the market.

Several jurisdictions, including Chicago, Portland, Austin, Denver, and Berkeley, have adopted residential energy disclo-

#### BY THE NUMBERS

*Expand Energy Benchmarking Program*

**CARBON SAVINGS**  
25,110 MtCO<sub>2</sub>e

**ANNUAL COST SAVINGS**  
\$7,441,115

#### BY THE NUMBERS

*Building Tune-Up Program*

**CARBON SAVINGS**  
183,380 MtCO<sub>2</sub>e

**ANNUAL COST SAVINGS**  
\$54,640,606



## BY THE NUMBERS

*Residential TOS Requirements***CARBON SAVINGS**1,125,830 MtCO<sub>2</sub>e**ANNUAL COST SAVINGS**

\$311,223,662

## BY THE NUMBERS

*Commercial TOS Requirements***CARBON SAVINGS**1,533,550 MtCO<sub>2</sub>e**ANNUAL COST SAVINGS**

\$432,233,682

sure policies for existing homes. Portland, the latest city to approve residential energy disclosure, will require single-family home owners to obtain a home energy score through a professional and disclose the score at time of listing for sale. Factors to consider for a residential disclosure policy include:

- **Timing of disclosure:** at time of listing, contract period, or at closing.
- **Method of disclosure:** utility data, home energy rating system (HERS), or Home Energy Score.
- **Where disclosure is posted:** Multiple Listing Service (MLS) listing or home inspection.
- **Costs to the buyer, seller, and agent.**
- **Resource availability:** City staff for implementation, home energy professionals, access to utility data.

### Energy Conservation Requirements at Time of Sale

Meeting the energy conservation code is currently required to receive a certificate of occupancy after construction or major renovation. Given the high percentage of buildings constructed prior to the advent of today's modern energy codes, requiring buildings to meet the energy conservation code or require other conservation measures at the time of sale (TOS) could have a significant impact.

Large commercial buildings frequently change ownership, which means TOS requirements could quickly result in energy savings. Frequent turnover may also make TOS requirements inefficient because they could result in substantial and expensive retrofits as frequently as every three years (the international code update cycle).

Residential properties, particularly rowhomes, change hands less frequently, but given the structural challenges in many of our city's rowhomes, implementing energy code requirements at time-of-sale may need to be part of a larger strategy to improve Philadelphians' homes.

To reduce the cost of compliance for sellers, Philadelphia could model this requirement after similar ordinances in San Francisco and Berkeley, California which require a list of measures subject to technical and financial feasibility.





**KEY PLAYERS**

*Lead by Example*

**Philadelphia Energy Office:**

Implements energy efficiency investments for city-owned buildings.

**Philadelphia Energy Authority:**

Provides technical expertise and holds long contracts for guaranteed energy savings projects.

**Philadelphia City Council:**

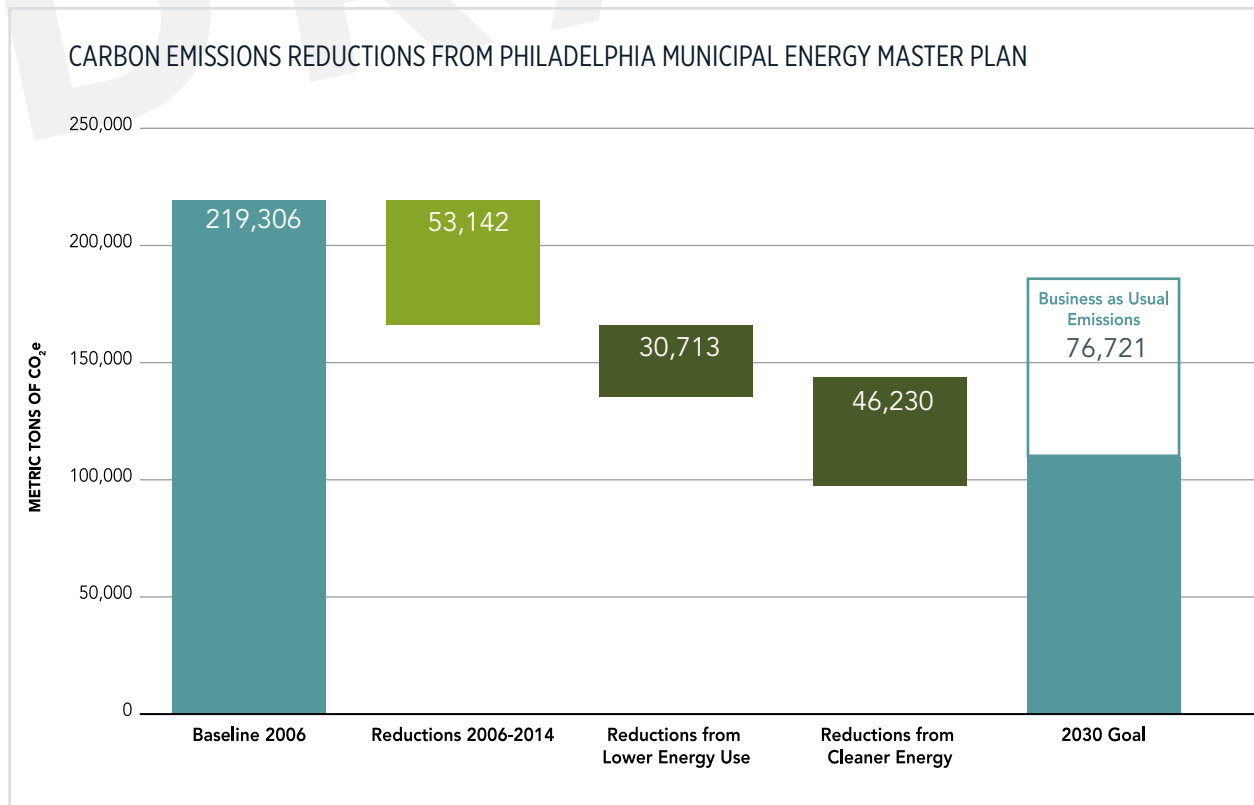
Allocates capital and operating funding for energy efficiency and approves long-term contracts.

**LEAD BY EXAMPLE**

Since 2013 the City of Philadelphia’s energy consumption has decreased, and the City’s carbon footprint has been declining since 2006. The City will deepen this progress and demonstrate leadership in climate action by continuing to reduce energy consumption and carbon emissions from its own buildings through strategies including:

- **Municipal Energy Master Plan:** The Office of Sustainability’s Energy Office recently published the city’s first energy master plan, which addresses centralized programs and actions that the City can take to reduce carbon emissions and improve efficiency in more than 600 City-owned facilities.
- **Philadelphia Museum of Art energy retrofit:** The City is preparing to launch a major energy retrofit on the Philadelphia Museum of Art, the single-largest energy user in the municipal portfolio.
- **Rebuild initiative:** Rebuilding Community Infrastructure (Rebuild) is a \$500 million program to upgrade parks, recreation centers, and libraries throughout Philadelphia. The Energy Office is developing energy efficiency guidelines to help reduce municipal energy usage as the City improves these assets for Philadelphia residents.
- **Energy Efficiency and Sustainability Fund:** The City will continue to implement the Energy Efficiency and Sustainability Fund, which provides operating departments funding through the Energy Office to invest in projects to improve the energy efficiency and sustainability of City-owned facilities.

**FIGURE 13**



Philadelphia’s Municipal Energy Master Plan sets long-term energy and carbon reduction targets for City-owned buildings and streetlighting. To read the plan, visit [www.phila.gov/green](http://www.phila.gov/green).



# Low-Carbon Thermal Energy

## WHERE WE'RE GOING

Today most of Philadelphia's homes and businesses are heated by burning natural gas (directly on-site or via the Veolia steam system) or fuel oil. By 2050 Philadelphia will dramatically reduce the carbon intensity of heating our buildings, through greater building efficiency or transitioning to new strategies and technologies to stay warmer in the winter months and comfortable in the summer.

This transition is already beginning. Buildings in Philadelphia today are heated by a variety of alternative energy technologies, including:

- **Biomass:** Energy derived from organic or plant-derived materials usually through combustion or transformation into various fuels. The carbon emissions from biomass exist primarily in the natural carbon cycle.
- **Renewable Natural Gas**
  - Biogas: Gas derived from the breakdown of biological sources (like agricultural waste or wastewater).
  - Landfill gas: Gas derived from the decomposition of municipal solid waste in landfills.
- **Geothermal energy:** In this document, geothermal energy refers to geo-exchange heat pump systems which use the constant temperature of the ground and a heat pump to heat and cool spaces.
- **Solar thermal:** In this document, solar thermal refers to hot water derived from solar heating collectors.

Each of these technologies have the potential to reduce carbon emissions in buildings while maintaining tenant comfort.

To meet our clean energy vision, electricity from a low-carbon grid must also play a larger role in heating our buildings. As we move toward a clean electricity supply, electrification of thermal energy becomes a viable low-carbon option. Newer electric heat pumps can function in cold climates like ours, and as these technologies continue to evolve, they will become a crucial tool for reducing carbon pollution. Expanding the use of district energy systems can provide both local electricity generation and cleaner thermal energy, lowering emissions while ensuring reliable operations of critical facilities like hospitals and shelters.

One important consideration in the evolution of these technologies is their cost-competitiveness. Many Philadelphia residents face economic challenges to heat their homes with existing technologies, and recent efforts by the federal government to cut funding for the critical Low-Income Heating Assistance Program (LiHEAP) could further harm low-income residents. PGW's Low Income Usage Reduction Program and Customer Assistance Program currently help reduce energy burden for low income households. The City is committed to monitoring the economic landscape of new thermal energy technologies and will advocate for opportunities to both cut carbon pollution and reduce the energy burden for our most vulnerable neighbors.

## Co-Benefits

### EQUITY

Many Philadelphians currently struggle to heat their homes, and emerging low-carbon thermal opportunities must ease the energy burden on those residents.

### HEALTH

Low-carbon thermal solutions displacing heating oil will improve regional air quality, reducing incidences of asthma and other respiratory illnesses.

### ENVIRONMENTAL

Reducing the burning of fossil fuels to heat our buildings will cut carbon pollution and improve the health of local natural resources.

### ECONOMIC

The transition to new thermal systems in Philadelphia buildings will create local clean energy jobs for Philadelphians.



## HOW WE'LL GET THERE

Most buildings in Philadelphia are currently heated by oil, on-site gas furnaces, or the Veolia steam loop. Emerging technologies like district energy systems, high-efficiency heat pumps, geothermal, solar heating systems, and renewable natural gas can reduce our reliance on fossil fuel energy for heating and domestic hot water, but are currently cost-prohibitive for the typical Philadelphia household.

The Playbook on the following pages outlines opportunities for the City and large institutions to lead by example by piloting these technologies to significantly reduce the carbon intensity of thermal energy in buildings they own and operate, while also studying further steps that can be taken to move toward this key component of Philadelphia's clean energy vision.

## WHAT YOU CAN DO

- **Explore all options for lowering carbon intensity of thermal energy** when replacing HVAC systems in your home or business. Depending on geography and cost considerations, some low-carbon thermal technologies are feasible for Philadelphia homes and businesses.
- **Invest in energy efficiency.** Cutting energy waste in your home or business will reduce the energy needed to heat your space, reducing your carbon footprint.
- **Advocate for research and incentives at the local, state, and federal levels.** Many of the emerging technologies in this field are the result of work done by federal research agencies at the Department of Energy, which are currently threatened by budget cuts. Both state and federal government currently provide incentives for some low-carbon thermal technologies, including geothermal and solar heating systems.

### Success Story: Geothermal at Bartram's Garden

In 2014 Bartram's Garden underwent a multimillion dollar restoration project, creating the new Ann Bartram Carr Garden and improving existing infrastructure. This major renovation provided a unique opportunity to install a geothermal heating and cooling system.

Geothermal heat pumps are a low-carbon, energy-efficient, and reliable option. Geothermal heat pumps use the steady temperature underground to harness energy through heat exchange. Because they do not burn fossil fuels, they generate far fewer greenhouse gas emissions than conventional furnaces. They are also efficient, using less electricity from the grid. Bartram's Garden expects a 53 percent decrease of electricity use going forward. Finally, geothermal is quieter than traditional heat pumps, ensuring a tranquil environment for visitors.

Bartram's Garden. (Source: Bartram's Garden)



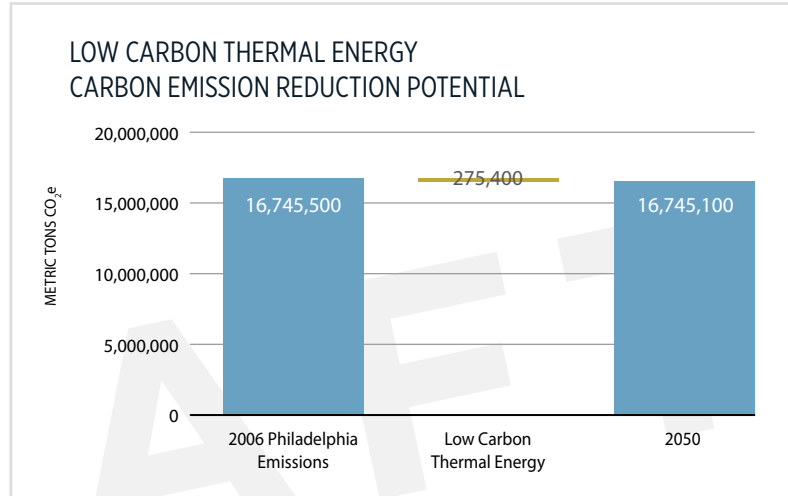


# Low-Carbon Thermal Energy Playbook

Achieving a low-carbon thermal energy future will require new technologies and practices in our homes and businesses, and policies and incentives to support those changes. Many of the playbook actions in this section require further research or technology development, and OOS and the City are committed to leading these efforts to help Philadelphia meet our low-carbon thermal energy goal. Implementing these strategies requires buy-in from multiple stakeholders, who are identified in the Key Players boxes.

There are limited opportunities to reduce carbon from the current thermal energy system that aren't accounted for by the clean energy supply and energy-efficient homes and businesses sectors. Achieving those goals will allow Philadelphia to dramatically lower emissions in this sector.

**FIGURE 14**



THERMAL ENERGY

<p><b>SCALE EXISTING AND EMERGING TECHNOLOGIES</b></p> <ul style="list-style-type: none"> <li>Track Low-Carbon Thermal Technology Development</li> <li>Evaluate District Energy System Opportunities</li> <li>Promote Geothermal Heating and Cooling</li> <li>Explore Solar Heating and Hot Water Systems</li> </ul>	<p>45</p>
<p><b>LOW-CARBON THERMAL STUDY</b></p> <ul style="list-style-type: none"> <li>Evaluate Philadelphia Gas Works (PGW) Business Operations</li> <li>Track Carbon Intensity of Thermal Electrification Strategy</li> </ul>	<p>46</p>



## SCALE EXISTING AND EMERGING TECHNOLOGIES

### Track Low-Carbon Thermal Technology Development

Many technologies that can be used to provide low-carbon thermal energy still need to mature (either technically or economically) before they can be adapted widely in Philadelphia. These technologies and solutions need to be tracked and studied to understand their potential and evaluate opportunities to pilot and scale across the city.

Electrification of heating and cooling using heat pump technologies such as mini-split systems, variable refrigerant flow, and hot water heat pumps are commercially available solutions for some homes and businesses today. As this technology continues to evolve, it must address the carbon intensity of refrigerants, a potent greenhouse gas that can have hundreds of times the heat-trapping potential of carbon. Advancements on heat pumps for use in cold weather heating also need additional research to ensure they can consistently meet the needs of Philadelphia winters.

National studies have shown that biogas and renewable natural gas could supply between four and ten percent of current natural gas usage. The City of Philadelphia uses biogas from its wastewater treatment plants to heat buildings and generate electricity. The City will continue to explore both biogas and renewable natural gas to understand what steps are needed to make these technologies cost-competitive and available to Philadelphia consumers.

### Evaluate District Energy System Opportunities

District energy systems use centralized heating, cooling, and sometimes electricity generation centers to provide energy to homes, businesses and institutions. When managed correctly, district energy systems use their large scale to maximize efficiency. For example, a large hot water plant serving several businesses is likely to operate more efficiently than if each business was served by their own individual boiler, because it can use larger, more efficient equipment and scale up and down to meet demand. Newer systems are designed to maximize heat recovery, provide resilience benefits, and reduce energy waste.

Philadelphia currently has several district energy systems providing thermal energy to businesses and institutions. Veolia Energy operates a natural-gas-fired district steam system, providing steam to institutions like the University of Pennsylvania and Drexel University and large buildings like the Comcast Center and the Philadelphia Museum of Art. Additionally, Penn and Jefferson University operate district chilled water systems on their campuses.

Many cities are currently exploring new district energy opportunities for new construction and large-scale neighborhood development, including incorporating microgrids (which can leverage solar photovoltaic and battery storage options to provide clean backup power to institutions). The City and other large institutions can explore potential investments in these systems, particularly in large new developments.

### Promote Geothermal Heating and Cooling

Geothermal exchange systems are a proven, extremely high-efficiency technology. A geothermal heat pump uses the steady temperature underground to harness energy through heat exchange. To be deployed further in a cost-competitive manner, these systems must overcome a few existing barriers:

- Geothermal exchange systems require significant access to open space and land. In a dense urban environment like Philadelphia, this limits the scale at which this technology is feasible, particularly for existing buildings.
- Geothermal exchange systems can have high capital costs due to the expense of drilling for horizontal or vertical well systems.

#### KEY PLAYERS

*Scale Existing and Emerging Technologies*

**City of Philadelphia and Issue Experts:** Tracking energy trends locally and globally.

**Large institutions:** The City, businesses, and universities can all lead by example to invest in low-carbon thermal technologies for new and existing buildings.



Even with these current barriers, geothermal systems can be a cost-effective choice in parts of Philadelphia where land is more readily available and accessible. The City has invested in geothermal in several facilities (see page 43) and can advocate to state and federal leaders that these clean thermal energy sources continue to be incentivized.

### Explore Solar Heating and Hot Water Systems

Solar hot water panels are a clean-energy technology for replacing certain types of heating systems. In many current systems, solar panels are used to heat water which is either used to provide domestic hot water to buildings or other heating systems (when combined with heat pumps). The City of Philadelphia can work to remove soft cost barriers by ensuring permitting of these systems is as smooth as possible while advocating for state and federal policies incentivizing solar investment.

In addition to solar hot water panels, as solar photovoltaic panels and battery storage technologies continue to evolve, they may open up new opportunity to provide additional clean thermal energy to Philadelphians, and OOS will continue to evaluate new technologies and inform residents and partners about those opportunities.

## LOW-CARBON THERMAL STUDY

### Philadelphia Gas Works (PGW) Business Operations Evaluation

PGW is the largest municipally-owned gas utility in the country, putting it in a unique position to help with the transition to a low-carbon future in line with the City's goals. PGW currently invests in energy efficiency through its Energysense program, helping reduce the carbon intensity of Philadelphia's thermal energy usage while reducing residents' and businesses' utility bills.

As Philadelphia transitions to a clean energy future, PGW and the City can work together to ensure the utility's business model is aligned with the City's clean energy goals while continuing to provide cost-effective thermal energy to residents. A full evaluation of PGW's current environmental impact and business opportunities in the low-carbon economy will help position the utility to thrive in a clean energy future. Among the key considerations in that evaluation should be:

- Opportunities to accelerate or alter gas line replacement plans, which will reduce natural gas losses which emit methane, a potent greenhouse gas.
- Evaluation of standards needed to inject renewable natural gas into PGW's existing infrastructure and the costs of using renewable natural gas to supply homes and businesses currently served by PGW.
- PGW's sourcing considerations when buying natural gas to evaluate if less carbon-intensive natural gas sources can be prioritized.
- PGW's business diversification opportunities both including and beyond natural gas distribution and sales.

#### KEY PLAYERS

##### *Low-Carbon Thermal Study*

**City of Philadelphia and Issue Experts:** Tracking energy trends locally and globally.

**Philadelphia Gas Works:** Publicly-owned utility responsible for heating nearly all of Philadelphia's buildings.

### Tracking Carbon Intensity of Thermal Electrification Strategy

Electrification of thermal energy requires a clean and decarbonized grid electricity. If grid emissions aren't improving at the pace needed, switching to electricity has minimal decarbonization benefits. OOS has been tracking the carbon intensity of the grid since 2008, and will continue to monitor and report on the efficacy of fuel-switching to electric heating to reduce carbon pollution.



# Low-Carbon Economy

## WHERE WE'RE GOING

The first four sections of the CEV lay out an ambitious energy future for Philadelphia: energy-efficient investment across Philadelphia's 600,000 buildings, thousands of new solar energy generation systems on our roofs and parking structures, and a commitment to transitioning the infrastructure that heats our buildings away from fossil fuels. Achieving this vision will require a dramatic transition to a low-carbon economy where economic growth no longer leads to increased carbon pollution, but reduces it.

In addition to generating new clean jobs, Philadelphia must grapple with existing industrial assets within our city. Philadelphia's industry produces "process emissions" (emissions derived from the generation of goods or industrial processes) that contribute to citywide carbon pollution. By 2050 these emissions will be cut at least 80 percent to ensure Philadelphia is on track to meet Mayor Kenney's 80 by 50 pledge.

To do so Philadelphia must embrace a triple-bottom-line approach, reducing carbon emissions while including all Philadelphians in a long-term vision for Philadelphia's economy.

## HOW WE'LL GET THERE

Reducing carbon pollution from industrial sources 80 percent by 2050 will require a rethinking of major parts of Philadelphia's economy, and some institutions are already planning for a low-carbon future. For instance, the Philadelphia Regional Port Authority is currently working to electrify large parts of its operations. To achieve the CEV's low-carbon economy goal, these efforts will need to be expanded and intensified in the coming years.

The City, residents, and other stakeholders will also need to work together to determine the future of the South Philadelphia oil refinery currently operated by Philadelphia Energy Solutions. The refinery is the single-largest source of particulate emissions in the city and alone accounts for nearly 16 percent of Philadelphia's carbon footprint, not including the fossil fuel products exported off-site. OOS is committed to leading a citywide conversation on the role of PES and other heavy industry as we move toward a clean-energy future.

### Co-Benefits

#### EQUITY

New low-carbon opportunities should be targeted toward residents historically disadvantaged by carbon-intensive industry.

#### HEALTH

A low-carbon economy will improve air quality, reducing the causes of asthma and other respiratory illnesses among Philadelphians.

#### ENVIRONMENTAL

Industry is among the biggest sources of carbon pollution in Philadelphia, and also impacts the quality of our air and waterways.

#### ECONOMIC

As Philadelphia shifts toward a low-carbon economy, we must connect displaced workers with job training and placement opportunities.



## Point-Source Pollution in Philadelphia

Both climate change and air quality are challenges that exist beyond city boundaries—climate impacts are global, and air pollution from our neighbors can drift into our city. But industry within Philadelphia also contributes local pollution, and the EPA and local Air Management Services track major sources of both carbon and air quality pollutants in the city.

Philadelphia's air quality is impacted by transportation, agriculture, industrial facilities, and natural sources. In 2016 Philadelphia ranked the 12th most polluted city in the U.S. by year-round particle pollution (PM2.5). PM2.5 and other particulate pollutants have negative effects on human health and the environment. For nearly all particulate pollutants, the single-largest source of local air pollution is the Philadelphia Energy Solutions (PES) refinery, which accounts for more than 50 percent of local emissions for each of those pollutants.

While not a particulate pollutant, carbon dioxide (the primary contributor to global climate change) is also emitted at the local level. Again, the PES refinery is the single-largest source of carbon emissions citywide. Other major point-sources for carbon emissions include the Port of Philadelphia and the Philadelphia International Airport. Addressing particulate and carbon emissions from these sources is necessary to achieving Philadelphia's health and sustainability goals.

## WHAT YOU CAN DO

- **Invest in energy efficiency or renewable energy in your home and business.** Taking advantage of the opportunities described throughout this report to improve the efficiency of local buildings or invest in renewable energy will create sustainable job opportunities locally, helping grow Philadelphia's economy and providing a model for climate-positive economic growth. PECO Smart Ideas and PGW's EnergySense programs offer incentives for building efficiency for residential, commercial, and industrial customers.
- **Join your local community group and raise environmental concerns.** Philadelphia has an existing network of Registered Community Organizations (RCOs) that advocate for neighborhood priorities. RCOs can help connect residents to efficiency or clean energy resources and raise neighborhood environmental concerns to the City or other regulatory bodies.
- **Advocate at the local, state, and federal levels.** Moving Philadelphia toward a low-carbon economy will require action across all levels of government. Consider joining a local environmental action group and let your elected officials know carbon reduction and job creation are priorities for you.



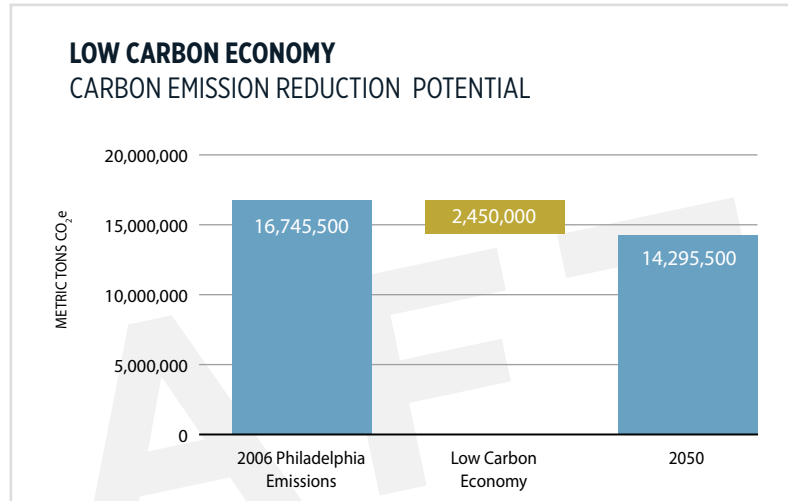


# Low-Carbon Economy Playbook

Nearly all the actions described elsewhere in the CEV will contribute to moving Philadelphia toward a low-carbon economy by spurring new job opportunities in energy efficiency, home weatherization, clean energy generation installation and maintenance, and community education and organizing. Below are specific opportunities to help hasten the transition to a low-carbon economy while producing economic opportunity for Philadelphians. Achieving this transition requires buy-in from multiple stakeholders, who are identified in the Key Players boxes.

Reducing carbon emissions from existing industrial sources 80 percent by 2050 will have a significant impact on Philadelphia's carbon footprint on its own. This graph does not include emissions reductions from each of the other four strategies outlined in the CEV, which together will help move Philadelphia toward a low-carbon economy that works for all our residents.

FIGURE 15



EXPAND PHILADELPHIA'S ENERGY COMMUNITY OF PRACTICE	50
Deepen Energy Collaboration	
Educate Philadelphians about Industrial Emissions	
SUPPORT PHILADELPHIA'S TRANSITION TO A CLEAN ECONOMY FUTURE	50
Implement Philadelphia Energy Campaign	
Prioritize Clean Economy in Supporting New and Existing Businesses	
Reduce Carbon Emissions from the Port of Philadelphia	





**KEY PLAYERS**

*Expand Philadelphia's Energy Community of Practice*

**Office of Sustainability:**

Will identify opportunities to convene new voices in Philadelphia's energy conversation.

**Residents, businesses, and technical experts:**

Will act as educators and sources of knowledge for their neighbors and decision-makers.

**EXPAND PHILADELPHIA'S ENERGY COMMUNITY OF PRACTICE**

As we developed the Clean Energy Vision, the Office of Sustainability (OOS) heard from hundreds of Philadelphians passionate about our city's energy future. However, those residents are just a fraction of the population of our city, and to achieve the goals in this document we need to engage Philadelphians in every zip code.

Deepen Energy Collaboration Citywide

To help facilitate conversations on how to achieve our vision of a clean and affordable energy future, the City of Philadelphia will collaborate with different segments of the city:

- **Community:** Philadelphia residents passionate about energy and climate can serve as educators within the community about the importance of individual and community action, while sharing neighborhood perspectives on priorities, opportunities, and hurdles with city leadership.
- **Institutions:** Leadership from major businesses, non-profits, academic partners, and utilities can commit to help Philadelphia meet its long-term energy and climate goals. Through energy purchasing, employee and resident engagement, and policy advocacy across all levels of government, these institutions can help hasten our transition toward a clean energy future.
- **Technical Experts:** Subject matters experts can advise OOS and other City partners on existing and emerging best practices in energy and climate policy, review potential programs and policies for technical hurdles, and provide guidance on the long-term trajectory of Philadelphia's climate action planning.

**KEY PLAYERS**

*Support Philadelphia's Transition to a Clean Economy Future*

**Philadelphia Energy Authority:**

Public authority responsible for leading the Philadelphia Energy Campaign.

**City agencies:** The Commerce Department, Office of Sustainability, and Philadelphia International Airport are among the many City departments who will help Philadelphia transition to a clean economy future.

**Residents and businesses:**

Philadelphians must continue to demand climate action and work to create clean economy jobs in our city.

Educate Philadelphians about Industrial Emissions

One early opportunity for CEV implementation is to convene conversations around the current impacts of large industrial facilities like the PES refinery on the health of our residents and the city's carbon footprint. Convening these conversations could allow parties to work together to identify opportunities to meaningfully improve the lives of impacted Philadelphians.

**SUPPORT PHILADELPHIA'S TRANSITION TO A CLEAN ECONOMY FUTURE**

Implement Philadelphia Energy Campaign

The Philadelphia Energy Authority, through the leadership and support of City Council President Darrell Clarke, launched the Philadelphia Energy Campaign in February 2016. The Campaign aims to create jobs, strengthen communities and cut energy bills while reducing Philadelphia's carbon footprint. The Campaign will leverage \$1 billion in public and private financing to invest in clean energy and energy efficiency projects in four key sectors: City buildings, Schools, low and moderate income residential housing and small businesses. To learn more about the development and successes of the Campaign, visit [www.philaenergy.org](http://www.philaenergy.org).



PEA estimates that work currently being piloted will, when brought to scale, create more than 10,000 jobs for Philadelphia residents. Fully implementing the Energy Campaign will help achieve all five of the CEV goals and provide opportunities for Philadelphians in the clean economy.

**Prioritize Supporting Clean Economy in New and Existing Businesses**

Since 2010 the City of Philadelphia has provided a sustainable business tax credit to 25 businesses each year who meet the B-Corp certification criteria (see [www.bcorporation.net](http://www.bcorporation.net)) or otherwise demonstrate a commitment to local sustainability in Philadelphia. In 2016 City Council increased both the value of the credit and the number of businesses eligible to receive it.

Moving forward, the City will launch a companion program for new sustainable businesses in 2018, and continue to evaluate opportunities to strengthen the tax credit to create new opportunities for businesses and residents in the clean economy.

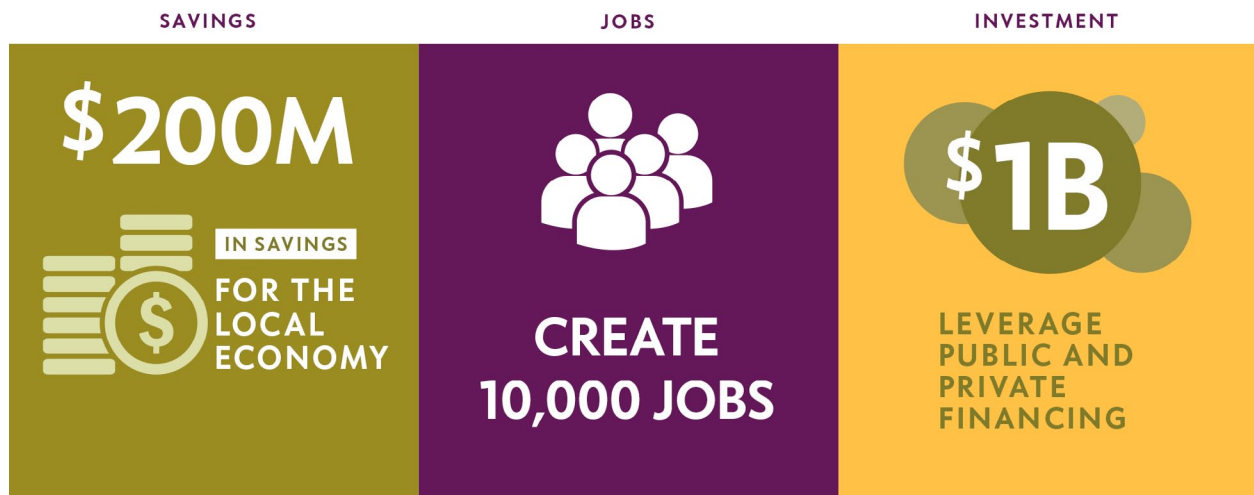
**Reduce Carbon Emissions from the Port of Philadelphia**

Since 2015 the Commonwealth of Pennsylvania has committed \$300 million to modernizing shipping operations at the Port of Philadelphia, including adding new electrified cranes and retrofitting existing cranes that were previously powered by diesel fuel. These changes will help make the Port of Philadelphia a more attractive destination for commerce in the years ahead, while reducing Philadelphia’s carbon footprint.

The Port and City of Philadelphia are exploring additional opportunities to invest in updating facilities to reduce carbon emissions. Future opportunities include retrofitting the last remaining backup diesel crane, electrification of other port systems, and retrofitting support vehicles across Port operations.



DRAFT



 **The Philadelphia Energy Campaign**



## What's Next?

Philadelphia's clean energy vision is a long-term initiative, but the City of Philadelphia is committed to taking immediate steps toward meeting the vision. These steps fall into three categories: leading by example, planning, and programs and policies.

### LEADING BY EXAMPLE

Since 2006 carbon emissions from City-owned and -operated buildings and streetlights have decreased by 24 percent. The City of Philadelphia will deepen this progress and demonstrate leadership in climate action by continuing to reduce energy consumption and carbon emissions from its own buildings. Strategies to meet this goal include:

- **Municipal Energy Master Plan:** The Office of Sustainability (OOS)'s Energy Office recently published the its first Municipal Energy Master Plan, which outlines opportunities for the City to reduce carbon emissions and improve efficiency in the more than 600 City-owned facilities and citywide street lighting network.
- **Philadelphia Museum of Art Energy Retrofit:** The City is preparing to launch a major energy retrofit on the Philadelphia Museum of Art, the single-largest energy user in the municipal portfolio.
- **Renewable Power Purchase Agreement:** As described on page 20, the City is currently seeking proposals to make a long-term commitment to purchase renewable energy from a large-scale wind, solar, or other renewable project in the region.
- **Energy Efficiency and Sustainability Fund:** The City will continue to implement the Energy Efficiency and Sustainability Fund, which provides operating departments funding through the Energy Office to invest in projects to improve the energy efficiency and livability of City-owned facilities.



Mayor Kenney speaking at a press conference for the release of the Municipal Energy Master Plan. (Photo: Samantha Madera)

### ENERGY PLANNING

Our clean energy vision was based in part on long-term planning conducted by OOS with support from ICF and issue experts throughout Philadelphia. OOS and partners in local government are committed to continued planning on long-term energy challenges identified in the vision, including:

- **Municipal energy planning:** Philadelphia's Energy Office released its Energy Master Plan in September 2017 to help improve the efficiency of city-owned buildings and use the City's buying power and public space to promote clean energy. The Philadelphia Water Department and Philadelphia International Airport are currently developing energy plans for their own operations.
- **Transportation action plan:** The Office of Transportation and Infrastructure Systems is developing a long-term vision for the future of Philadelphia's transportation network. Sustainability and equity are core values of the effort, which will launch with a comprehensive outreach program to help develop the vision in 2018.
- **PGW longevity planning:** Philadelphia Gas Works is the largest municipally-owned gas utility in the country, and the City is committed to maintaining the value of that asset to taxpayers while meeting Philadelphia's climate and energy affordability goals. The City of Philadelphia and PGW are committed to exploring pathways which can meet each of these challenges.



- **Opportunities to reduce carbon emissions from local industry:** Large industrial sites like the Philadelphia Energy Solutions refinery are major resources of carbon pollution. The City will work with those entities, impacted residents, and partners within City government to understand opportunities to reduce emissions and improve public health around local industry.
- **Exploration of district energy and microgrids:** Critical buildings in Philadelphia (including hospitals, shelters, and public safety facilities) require reliable energy to provide essential services to residents in the case of emergency. This need may grow as the climate changes and emerging technologies like district energy systems or microgrids can provide this resilience while reducing carbon emissions. The City will work with the owners of these critical facilities to understand existing backup systems and identify opportunities to work together to advance district energy or microgrid solutions where needed.

## PROGRAMS AND POLICIES

OOS will work with community stakeholders and advocates to understand where there is collective interest in moving ahead with initiatives described throughout this document. Several areas where action is already happening include:

- **Expand energy engagement with residents and businesses:** One of the primary goals of developing a city-wide energy vision is to help Philadelphians better understand the opportunities and challenges of climate action. OOS is committed to using this report in 2018 and beyond to inform Philadelphians about opportunities to move toward a clean and sustainable energy future.
- **Build on initial success of Solarize campaign:** Nearly 2,000 Philadelphia homeowners signed up for the first round of Solarize Philly, indicating the significant interest for solar generation in our city. The Philadelphia Energy Authority and its partners intend to grow this program in 2018.
- **Continue to ease solar installation in Philadelphia:** OOS and the Department of Licenses + Inspections have worked together to improve the solar permitting process, leading to an update of the City's expedited solar permit standard in 2016, and will continue to work with residents and solar installers to identify opportunities to improve this process.
- **Work with City Council and residents to identify policy priorities:** Many of the strategies identified in the Play book sections of the CEV will require action by Philadelphia City Council. OOS will continue engaging Council and Philadelphia residents about their energy and climate priorities in 2018 and beyond to help work toward our clean energy vision.

## PUBLIC COMMENT

*Powering Our Future* is being released as a public draft to solicit additional feedback from residents, issue experts, and advocates. OOS will incorporate these results and other feedback into the final version of this report. You can complete a survey on this report by visiting [www.phila.gov/green](http://www.phila.gov/green) or connect with us directly by emailing [sustainability@phila.gov](mailto:sustainability@phila.gov).



# Appendix: Energy Modeling Assumptions

The Clean Energy Vision (CEV) is based on research and modeling completed by the Office of Sustainability (OOS) with the support of consultants with ICF. Listed below are some of the key assumptions that were made to create the analysis shown throughout this report. For more information, please contact OOS at [sustainability@phila.gov](mailto:sustainability@phila.gov).

## GENERAL MODEL ASSUMPTIONS

The CEV uses population projections from DVRPC and assumes current construction rates continue to estimate increase in electricity and natural gas demand through 2050. Current emissions from Philadelphia's built environment are derived from citywide PECO and PGW data along with supplementary information on individual buildings from the city's energy benchmarking program. The modeling in this report assumes a zero-carbon grid is technically feasible, but does not make any assumptions about the technologies or costs required to achieve it.

## CLEAN ELECTRICITY SUPPLY

The CEV considers two electricity supply scenarios and assumes carbon intensity (CO<sub>2</sub>e/MWh) pathways for each scenario. The business-as-usual scenario assumes the carbon intensity of the grid follows the Energy Information Agency's generation fuel mix projections.

The clean electricity supply grid scenario assumes the regional electricity grid follows a linear reduction trend to zero carbon emissions in 2050. This scenario does not make assumptions about which technologies or generation sources will be used in the zero-emissions grid.

## CITYWIDE SOLAR

The CEV projections for solar generation within the city are based on existing solar panel technology. A study by Penn State University found that nearly half of Philadelphia rooftops are suitable for solar generation, and the CEV assumed that 80% of these rooftops were producing electricity from solar by 2050. The resulting electricity generation is treated as a portion of the clean electricity supply.

## ENERGY-EFFICIENT HOMES AND BUSINESSES

Data from PECO, PGW, and the energy benchmarking program were used as a baseline for modeling programs in the Energy-Efficiency Playbook.

Key assumptions for specific programs include:

- Commercial and Residential Energy Codes: Philadelphia adopts new building code with each triennial International Code Council update through 2030 and 75% of new construction and major renovations completed through 2050 comply with code.
- Residential Energy Code Enforcement for Renovations and Additions: Building codes continue to become more energy efficient through 2030, and all renovations completed through 2050 meet code.
- Third-Party Energy Code Compliance: Compliance rates increase from an estimated 75% to 95% for residential properties.
- 2030 District: 70% of existing buildings in Center City and University City meet the 2030 District targets.
- Permit Streamlining: Streamlining leads to 75% of expected new construction meeting LEED or ENERGY STAR standards.



- Density Bonus: 30 new properties take advantage of bonus annually.
- Property Tax Incentives for High-Performing New Buildings: 50% of new office space in Center City and University City take advantage of incentives.
- Utility-Funded Efficiency Opportunities: Act 129 savings targets extend to 2050 with an annual savings rate of 1.1%.
- Expanded Energy Benchmarking Program: Benchmarking threshold is reduced to 25,000 square feet. 90% of buildings comply, and they reduce energy use 2% annually.
- Building Tune-Up Program: Program applies to buildings 25,000 square feet and larger, and 75% of eligible buildings comply, achieving 10% one-time savings.
- City Government Leading by Example: For more on this analysis, see the recently released Municipal Energy Master Plan, available at [www.phila.gov/green](http://www.phila.gov/green).

## LOW-CARBON THERMAL ENERGY

The Low-Carbon Thermal Energy section assumes that natural gas and fuel oil use for heating, hot water, and cooking will be partially displaced by new no- and low-carbon technologies. The model assumes that 70% of residences and 30% of commercial buildings will use these new technologies by 2050. The model does not make any assumptions about which technologies will be used.


## LOW-CARBON ECONOMY


The city's greenhouse gas inventory includes emissions from Philadelphia's local industry. The inventory includes large point source emissions from the EPA's Greenhouse Gas Reporting Program tool and Philadelphia's share of additional industrial emissions from the Pennsylvania Department of Environmental Protection greenhouse gas inventory. The Low-Carbon Economy section assumes that the carbon dioxide-equivalent output of industry is 80 percent lower by 2050.



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