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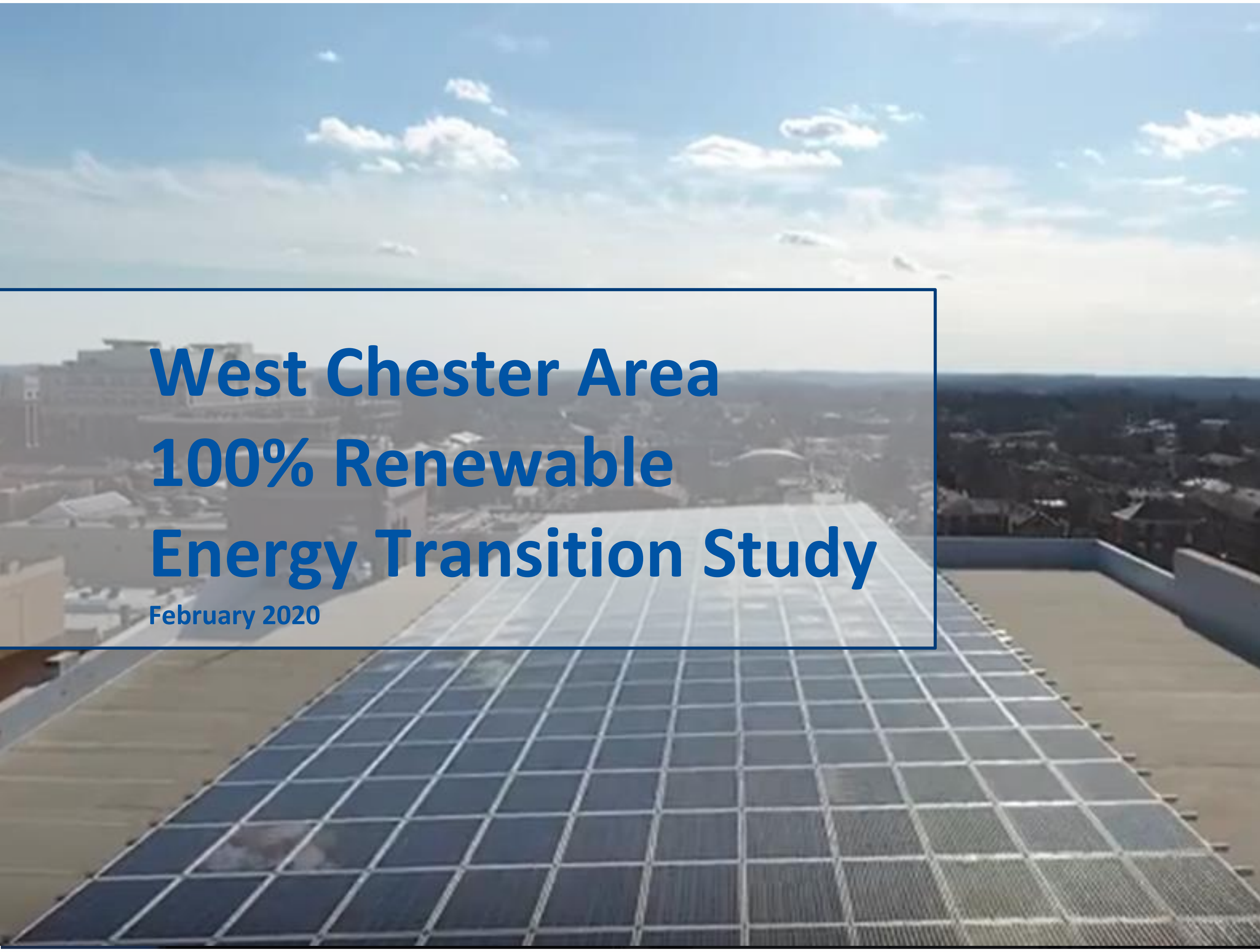

West Chester Area 100% Renewable Energy Transition Study

February 2020

Prepared for:

West Chester Area Council of Governments

Acknowledgements

The Cadmus Group developed this resource in collaboration with the West Chester Area Council of Governments and the project advisory group. Project participants are listed below:

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Introduction and Background

West Chester Area Renewable Energy Goals

The Townships of East Bradford, East Goshen, West Goshen, Westtown, West Whiteland and the West Chester Borough, Pennsylvania, are working with the West Chester Area Council of Governments (WCACOG) to study the pathways for utilization of:

- 100% renewable electricity by 2035
- 100% renewable energy for heat and transportation by 2050.

West Chester Borough and East Bradford Township have formally adopted these goals via a 100% Renewable Energy Vision Resolution[1,2] and plan to utilize this report to consider pathways for achieving these goals. The remaining Townships plan to utilize the findings of this report in evaluating the potential adoption of these goals.

In 2019, the six participating municipalities collectively hired the Cadmus Group to complete a study on the feasibility, costs, and opportunities of this transition, and to create a long-term, actionable roadmap for realizing the community's goals.

Objective and Approach

Local governments across the United States and globe employ a wide range of strategies to support the transition to renewable energy (RE). The viability and impact of these strategies varies depending on contextual factors, such as state-level regulation, utility type, and local factors. The purpose of this report is to provide the West Chester Area (WCA) municipalities with actionable strategies given their specific policy and regulatory context to achieve their renewable energy goals along with targeted implementation guidance for pursuing the selected strategies. Note that for the purposes of this report renewable energy sources are considered to include wind, solar, hydropower, and biomass. The Cadmus Team's process for identifying these strategies is summarized in Figure 1 below and outlined in more detail in the Strategy Analysis and Findings section:

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[1] East Bradford Township. Resolution #24-2018. https://www.eastbradford.org/download/government/Res-2018-24-Energy-Resolution.pdf

[2] West Chester Borough. Resolution No. 12-2017. https://west-chester.com/DocumentCenter/View/9718/Resolution-12-2017?bidId=

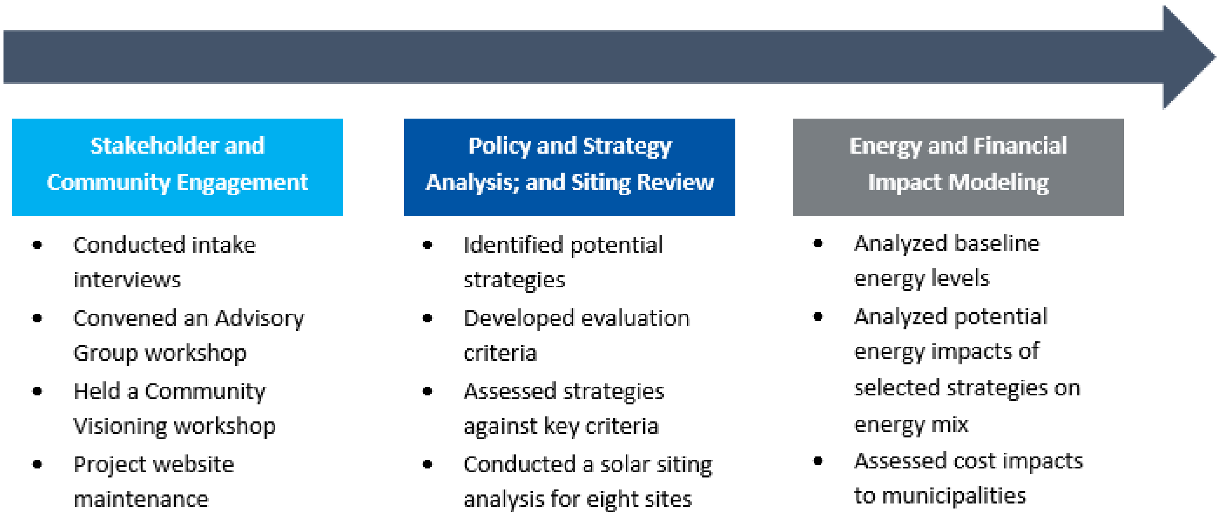

Figure 1: Summary of Cadmus Process

1. **Stakeholder and Community Engagement.** At the outset of the project, the Cadmus Team conducted a series of engagement efforts to ensure the forthcoming research and analysis is grounded in local goals and perspectives. A summary of these engagements is included below. For more detailed information, please see Appendix A.
    - *Advisory Group Input*: Throughout the project, the Cadmus Team received continuous input from a 12-person Advisory Group comprised of individuals who represent participating municipalities of the Council of Governments (COG). Representatives from the Advisory Group met with the Cadmus Team weekly to provide guidance and input on key aspects of the study. Additionally, the full 12-person Advisory Group reviewed draft findings from each of the major components of methodology.
    - *Interviews*: The Cadmus Team conducted one-hour intake interviews with six Advisory Group members and one additional stakeholder. During these conversations, interviewees provided feedback on what excites them and concerns them about renewable energy transition, as well as their vision for the West Chester Area's energy future and strategies they feel will help them reach their goals.
    - *Advisory Group Workshop*: The Cadmus Team facilitated an in-person 2.5-hour workshop with the full Advisory Group on July 11th to solicit further feedback from the Advisory Group and prepare for a Community Visioning Workshop held in the West Whiteland Township building later that day.
    - *Community Workshop*: The Cadmus Team held a community visioning workshop during which the Advisory Group members and the Cadmus Team facilitated conversations with community members to begin to define a community energy vision for 2050, to identify different community priorities, and discuss the community's specific needs, challenges, and desired outcome for the project. The workshop had approximately 60 attendees, who were divided into seven breakout groups for discussions.

2. **Policy and Strategy Analysis & Siting Review**. Based on stakeholder and community feedback, the Cadmus Team's prior work with municipal governments nationwide, and desk research on the West Chester Area's state, utility, and local context; the Cadmus Team compiled an initial list of 42 strategy options across the electricity, transportation, and building sectors that could be leveraged to achieve the West Chester Area's 2035 and 2050 goals. The Cadmus Team shared this initial list of strategy options with the Advisory Group members, which then conducted a prioritization exercise to select the top 18 strategies to analyze further. For each of the top 18 strategies, the Cadmus Team analyzed and ranked each strategy on a scale of one (low) to three (high) against key criteria including potential scale of impact, technical and political feasibility, as well as financial impact. Further details on the criteria and results of the analysis can be found in the Strategy Analysis and Findings section and the full list of the initial 42 strategies can be found in Appendix B. Additionally, the Cadmus Team conducted a solar feasibility analysis for multiple municipally-owned sites across the WCA. The full details of this analysis can also be found in the Appendix.
3. **Energy and Financial Impacts Modeling.** At the outset of the modeling task, the Cadmus Team first conducted research on the current mix of electric power sources for the West Chester Area, and developed a business-as-usual forecast of likely changes in the electric power mix during the planning period (present-2050). Next, the Cadmus Team assessed the likely energy impacts each selected strategy would have toward increasing the share of renewable energy in the West Chester Area's supply mix, as well as the potential costs associated with each strategy or policy. To conduct this modeling work, the Cadmus Team conducted research on local and state context, drawn on its existing database of local government policy impacts and experience in conducting energy sector modeling for cities, and consulted with the Advisory Group members to refine the model inputs. Further details on the modeling methodology and assumptions can be found in Appendix C.

Key Limitations

This study focuses on strategies that will support a transformation of the WCA's energy system. While energy efficiency (EE) plays a significant role in this transformation, actions to improve efficiency are not sufficient to achieve the WCACOG's goals. Therefore, while gains in efficiency are not the focus of this report, they are considered in the baseline model. Additionally, the report includes high-level guidance on EE strategies and key resources for next steps in Appendix D. Furthermore, this study focuses on the changes needed to the renewable energy supply to transform the WCA energy system and is not a greenhouse gas emissions accounting exercise. Lastly, the results of this study should be refreshed periodically to account for local progress against initial strategies, technology advancement, electricity market changes, and other contextual updates.

Electricity Landscape

State Context

There are several state policies and programs that both support and limit renewable energy deployment in Pennsylvania. Key state policies are listed below.

- **Deregulated Market**. The state of Pennsylvania has a deregulated electricity market.[3] In deregulated electricity markets, investor-owned utilities are not permitted to own and operate power plants that generate electricity. Instead, retail customers are free to purchase electricity from a competitive supplier, and the utility continues to provide distribution services. Within the West Chester Area, PECO (formerly the Philadelphia Electrical Company) is the electric utility. There are several competitive energy suppliers active in Pennsylvania offering retail customers a range supply options that include different electricity sources and prices.[4]
- **Pennsylvania Alternative Energy Portfolio Standard (AEPS).** This standard requires all electric distribution companies and electric generation suppliers in the state to supply 18% of electricity with "alternative" energy sources by 2021. The APS mandates that 8% of electricity must be generated from Tier I resources,[5] while the remaining 10% must be generated from Tier II resources.[6] The AEPS also includes a solar carve-out, requiring 0.5% of electricity be generated from solar photovoltaic (PV) by 2021.[7]
- **Net Energy Metering.** State law requires investor-owned utilities to allow certain customers to net meter excess electricity that is produced by eligible systems. Customer groups eligible for net metering in Pennsylvania include residential customers with systems that generate up to 50 kW, non-residential customers with systems that generate up to 3 MW, and customers with systems generating between 3-5 MW that also serve as micro-grids and emergency systems. Systems eligible for net metering include solar PV, solar thermal, wind, hydropower, geothermal energy, biomass, fuel cells, combined heat and power, municipal solid waste, waste coal, coal-mine methane, and other forms of distributed generation as well as certain demand-side management technologies.[8] Customers who participate in net metering receive credits valued at the full retail rate for every excess kWh produced by the system each month, and excess credits

[3] Cadmus. Pathways to 100. https://cadmusgroup.com/papers-reports/pathways-to-100-an-energy-supply-transformation-primer-for-u-s-cities/

[4] PA Power Switch. Shop for Electricity. https://www.papowerswitch.com/

[5] **Tier I resources** include: photovoltaic energy, solar-thermal energy, wind, low-impact hydro, geothermal, biomass, wood pulping and manufacturing byproducts from energy facilities within the state, biologically-derived methane gas, coal-mine methane, and fuel cells. (DSIRE)

[6] **Tier II resources** include new and existing waste coal, distributed generation systems less than 5 MW in capacity, demand-side management, large-scale hydro, municipal solid waste, wood pulping and manufacturing byproducts from energy facilities located outside of the state, useful thermal energy, and integrated gasification combined cycle coal technology. (DSIRE)

[7] DSIRE. July 2018. Alternative Energy Portfolio Standard. https://programs.dsireusa.org/system/program/detail/262.

[8] DSIRE. November 2019. Net Metering. https://programs.dsireusa.org/system/program/detail/65

roll over month-to-month.[9] Pennsylvania's net metering rules also allow for meter aggregation and virtual meter aggregation for meters belonging to the same customer that are located within two miles of the customer's property within a single utility's service area.[10] Net metering is a useful policy for supporting the development of distributed renewable energy generation as it provides compensation for excess energy generation contributed to the grid.

- **Third Party Ownership.** The state permits third party ownership in the form of leases and power purchase agreements (PPAs). Both structures allow a third-party, such as a RE developer, to build, own, and operate a RE system on behalf of a host customer. This model enables customers to avoid the upfront costs of distributed RE installation and it allows tax-exempt entities (e.g., governments and non-profits) that do not have direct access to federal and state tax credits to leverage these incentives.
- **Community Solar.** House Bill 531 and its companion, Senate Bill 705, are currently under consideration, and, if passed, would allow for community solar in Pennsylvania.[11] Community solar projects, sometimes referred to as solar gardens, are usually large solar PV arrays, which produce clean electricity that community members across multiple properties are eligible to purchase.[12] Currently, solar energy in Pennsylvania and its benefits are only available to persons and entities who own property upon which solar can be installed. The proposed community solar program would expand access to solar energy significantly by enabling anyone with an electric bill, such as renters, to subscribe to a share of a solar array in a different location than their residence or business. Subscribers would receive a credit on their electricity bill for the share of renewable electricity to which they are subscribed.[13]
- **Solar Renewable Energy Certificates (SRECs).** An SREC is a Renewable Energy Certificate that denotes ownership of solar energy. Pennsylvania is one of seven U.S. states that have a solar carve-out that requires utilities to purchase Solar Renewable Energy Certificates to meet the renewable energy portfolio standards. The value of SRECs varies depending upon market supply and demand at any given time, as of February 2020, the value of one SREC in Pennsylvania was approximately $40/MWh of electricity.[14] There have been recent changes within the Pennsylvania SREC market that may increase the value of SRECs in the state, and more changes may follow in the coming years.[15] Most recently, *2017 Act 40*[16] limits the ability of out of state

[9] Energy Sage. January 2020. PECO Energy Net Metering. https://www.energysage.com/net-metering/peco-energy/ .

[10] DSIRE. November 2019. Net Metering. https://programs.dsireusa.org/system/program/detail/65

[11] Solar United Neighbors. Make Community Solar a Reality in Pennsylvania. https://www.solarunitedneighbors.org/pennsylvania/take-action/community-solar-reality/.

[12] EnergySage. *Community Solar.* https://www.energysage.com/solar/community-solar/community-solar-power-explained/

[13] Pennsylvania House of Representatives. January 2019. House Co-Sponsorship Memoranda: Community Solar Legislation. https://www.legis.state.pa.us//cfdocs/Legis/CSM/showMemoPublic.cfm?chamber=H&SPick=20190&cosponId=27796

[14] SRECTrade. *Pennsylvania*. https://www.srectrade.com/markets/rps/srec/pennsylvania

[15] EnergySage. *SRECs in Pennsylvania: prices, projections, and program status*. https://news.energysage.com/srecs-in-pennsylvania-prices-projections-and-program-status/

electricity generators to participate in the Pennsylvania SREC market. In past years, out of state electricity generator participation was high in the Pennsylvania market, which drove down prices.

Utility Context

The West Chester Area municipalities are located within PECO's service territory for electricity service. PECO is an investor-owned utility that provides electricity and natural gas service to 1.6 million electric customers and 511,000 natural gas customers across Southeastern Pennsylvania.[17] PECO supports renewable energy in Pennsylvania by offering net metering, as required by state policy, and through the provision of education materials on key renewable energy topics, including interconnection[18] and renewable energy financing options.[19] PECO also offers several energy efficiency (EE) focused incentives and programs, including home energy assessments and a range of discounts and rebates for energy efficient appliances.[20] The Pennsylvania Public Utilities Commission (PUC) regulates investor-owned utilities in Pennsylvania, including PECO, and is responsible for ensuring reliable service at reasonable rates.[21]

Local Policies and Initiatives

In addition to state-level policies, local actions also shape the landscape for potential future energy actions. West Chester Area municipalities have taken steps to support the deployment of local renewable energy. Beyond supporting the 2035 and 2050 renewable energy goals and the development of this report, selected highlights across the municipalities include:

- West Chester Borough installed a **72-kW solar canopy** on the Chestnut Street Garage roof in 2009.
- East Goshen has formed a **Sustainability Advisory Committee** to discuss environmental, economic, and social sustainability.
- West Goshen applied for **funding to install 2 EV charging stations** at the Township building (if successful installation will happen spring 2020).

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[16] Pennsylvania General Assembly. 2017 Act 40. https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2017&sessInd=0&act=40
[17] PECO. Company Information. https://www.peco.com/AboutUs/Pages/CompanyInformation.aspx
[18] PECO. DER Interconnection Viability. https://www.peco.com/MyAccount/MyService/Pages/DERInterconnectionViability.aspx
[19] PECO. Solar for Homes and Businesses. https://www.peco.com/SmartEnergy/MyGreenPowerConnection/Pages/SolarforHomeBusiness.aspx
[20] PECO. For Your Home. https://www.peco.com/WaysToSave/ForYourHome/Pages/Default.aspx
[21] Pennsylvania Public Utility Commission. Mission Statement. http://www.puc.state.pa.us/about_puc.aspx

- **Solarize[22] Southeastern Pennsylvania** was established in 2019 and over 30 homeowners signed contracts for solar PV installations. Another campaign is anticipated in 2020 with a renewed focus on Chester County.[23]

Additionally, the Sierra Club has an active Southeastern Pennsylvania chapter and Ready for 100 team that provides education opportunities to the local community. Some examples include:

- The Chester County 100% Renewable Energy Expo and Discussion
- Ready for 100 After the Resolution Conference and Discussion

Ready for 100 Parade

Solar PV on Westtown School Althetic Center

[22] U.S. Department of Energy. Office of Energy Efficiency and Renewable Energy. Solarize Guidebook. https://www.energy.gov/eere/solarpoweringamerica/solarize-guidebook

[23] Solarize Southeast PA. https://solarizesoutheastpa.com/

Current Energy Consumption and Baseline Projections

Overview and Methodology

To better assess the scale of change needed to achieve West Chester Area's 2035 and 2050 renewable energy goals, it is important to understand the current breakdown of energy generation sources, utility projections for future electricity generation, and baseline forecasted energy consumption and supply. This analysis outlines the current energy generation sources throughout the West Chester Area and the expected changes to the electricity supply through the year 2050.

To determine the amount of energy consumed by the townships, the Cadmus Team began by aggregating data on energy use in the building and transportation sectors.[24] Next, the energy consumption of each sector was broken down to determine the source of energy (i.e. either electricity or another fuel source). The electricity mix for the region was then disaggregated into its composite sources. Figure 2 visually represents the baseline energy modeling methodology.

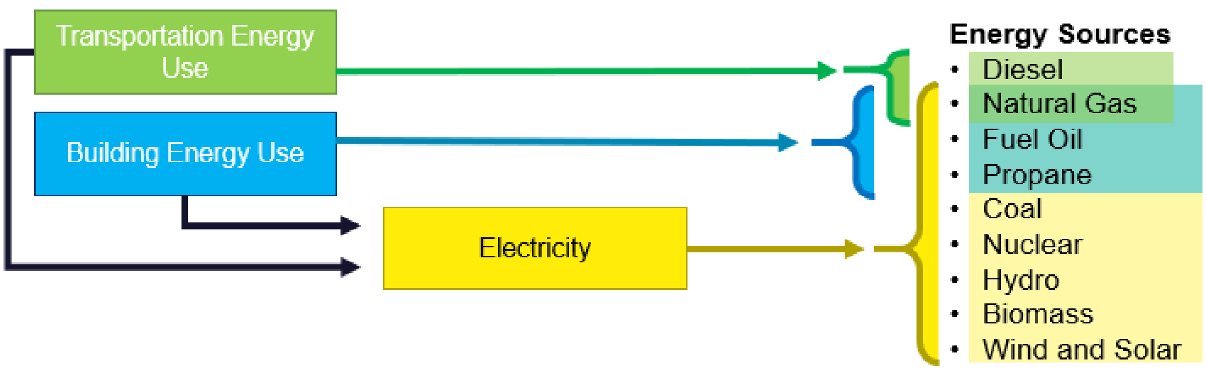


Figure 2: Energy Model Workflow

Current Energy Consumption

Based on most recent available data, the West Chester Area consumes approximately 14,000 billion BTU annually. West Chester's energy mix is 27 percent electrified, with the remaining energy coming from direct fossil fuel consumption. Over one third of the energy consumed is sourced from gasoline and diesel for the transportation sector. Natural gas, fuel oil, diesel, and propane are primarily used for heating in buildings, and account for about 36 percent of the mix. Of the heating fuels, natural gas is the most prominent, and is consumed significantly for electricity generation as well.

[24] Data sources used to figure the current consumption in the building sector was derived primarily from U.S. Census data and Delaware Valley Regional Planning Commission (DVRPC) 2015 Greenhouse Gas Emissions Summary. Data for the transportation sector are mainly sourced from U.S. Census data, Energy Information Administration (EIA), and the Southeastern Pennsylvania Transportation Authority (SEPTA).

West Chester's electricity mix is heavily dependent on non-renewables. A third of the energy comes from nuclear power plants, and a slightly smaller share from natural gas plants. Coal consumption decreased significantly over the last decade but still supplies approximately 20 percent of electricity, more than renewables. Renewables, such as wind, solar, hydropower, and biomass, make up just over 1 percent of the overall energy mix. Figure 3 illustrates the energy consumption by fuel type and electricity source.

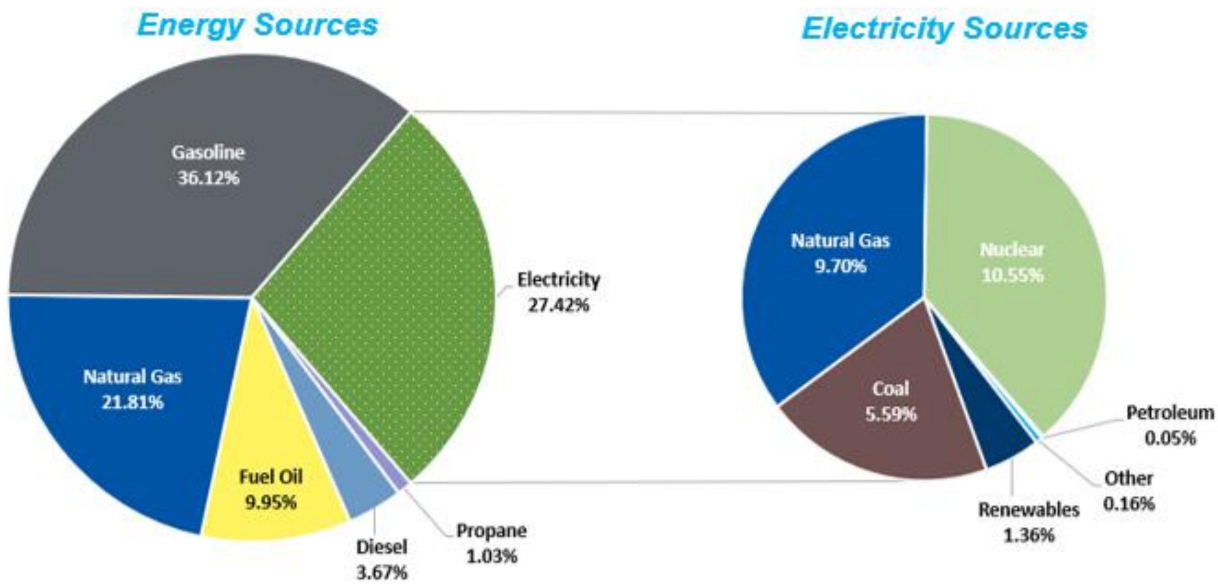


Figure 3: Energy Consumption by Fuel Type

As seen in Figure 4 below, the buildings sector constitutes 60% of all energy consumed in the West Chester Area. Of that 60%, 37% comes from commercial and industrial buildings, and the remaining 23% is consumed by residential buildings. Most of the energy consumed in commercial buildings comes from electricity and natural gas whereas residential buildings primarily consume natural gas. The transportation sector predominantly uses gasoline, with a relatively small share of diesel. Electric vehicles (EV) currently comprise a minimal amount of transportation energy consumption.

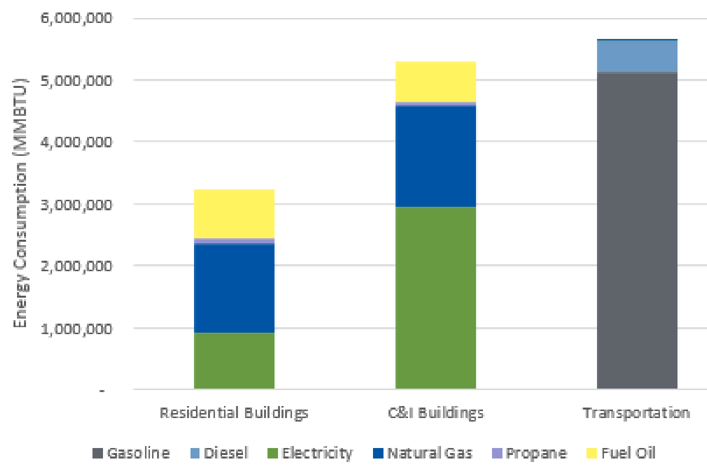
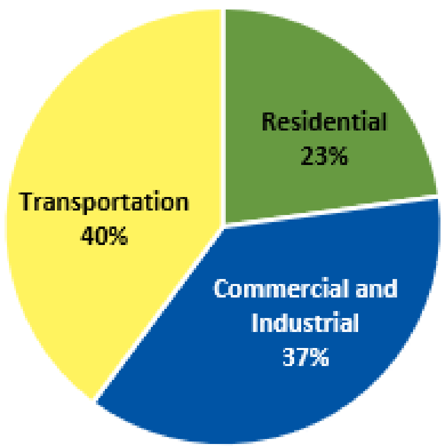


Figure 4: Breakdown of Energy Consumption by Sector and Fuel Source in 2018



Baseline Scenario

The purpose of a baseline scenario is to model West Chester Area's likely electricity mix in 2035 and 2050 without any additional action from the municipalities or state. The baseline scenario projects West Chester Area's community-wide electricity mix until 2050 based on planned additions and retirements in Pennsylvania's electric grid. Given that the electricity sector offers the greatest near-term potential for renewables transformation, most of the strategies selected by the WCA participating municipalities focus on the electricity sector. As such, the baseline model also illustrates the electricity sector.

The baseline model accounts for the shutdown of the Three Mile Island nuclear power plant in 2019, which provided just over 3% of the state's electricity generation. It also incorporates the phaseout of coal with a 10% compounded decrease every year moving forward, extending the trend seen in the past decade. Renewables are expected to increase based on targets set by the Pennsylvania Alternative Energy Portfolio Standard for Tier 1 resources and are projected to grow at a constant annual rate of 0.5% after the target of 8% Tier 1 renewables is reached by 2021.

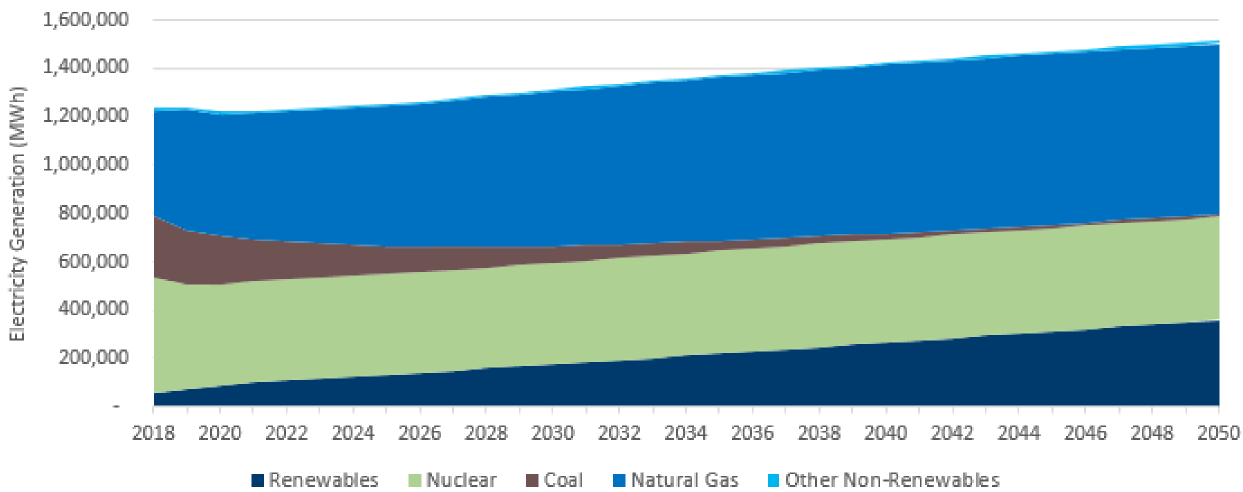


Figure 5: Current Projected Electricity Generation by Fuel Source

Key Takeaways from the Baseline Scenario

The model projects the following baseline milestones:

- Overall electricity consumption increases by 21 percent over the modeled period due to both projected population growth and electrification of the building and transportation sectors. The results of this baseline model account for a 3% reduction in electricity demand through 2050 due to energy efficiency gains as projected by the Energy Information Administration.
- **By 2019:** Natural gas overtakes nuclear as the primary fuel source for electricity. This is largely due to the planned retirement of the nuclear power plant on Three Mile Island.
- **By 2040:** Coal is almost entirely phased out of the electricity mix and replaced by natural gas.
- **By 2050:** Renewables make up 22.5 percent of the electricity mix. This increase is due to abiding by the Pennsylvania Alternative Energy Portfolio Standard (AEPS), and an assumed constant growth after the AEPS target year of 2021.

In sum, over the 30-year modeling period, West Chester Area's building and transportation end-uses are progressively electrified, which increases overall electricity demand. Meanwhile, the electricity mix is projected to become more and more powered by renewable resources as coal is phased out and renewable prices decline. Collectively, these trends will support West Chester municipalities in their efforts to reach 2035 and 2050 renewable energy goals, but not at a sufficient scale. Currently, renewable energy generation is minimal in all sectors for the participating municipalities. Specifically, in the baseline scenario, renewables are projected to reach a 22.5 percent share of the electricity mix by the end of the 30-year modeling period. However, West Chester municipalities still have significant opportunity to accelerate and scale these trends through policy and programmatic action. Specifically, in the following section of the report, the Cadmus Team's analysis focuses on pathways for municipalities to (1) increase renewable generation within the electricity supply mix in the near-term, and (2) accelerate electrification of building and transportation end-uses over the mid- to long-term.

The near-term policies that enable and increase the renewables in the electricity system are of great importance to reaching the WCA municipalities renewable electricity goals. Next, a longer-term goal to electrify the building and transportation sectors is necessary to reach a fully renewable energy supply. This means that electricity will need to replace natural gas and fuel oil in the buildings sector and gasoline and diesel in the transportation sector.

Strategy Analysis and Findings

Strategy Analysis Methodology

Policy Analysis

There are numerous strategies that the West Chester Area Municipalities could undertake in an effort to achieve their renewable energy goals. As noted previously, renewable energy sources include wind, solar, hydropower, and biomass. To identify a subset of strategies that would be appropriate and effective in the West Chester Area context, the Cadmus Team first compiled an initial list of 42 strategy options spanning the electricity, transportation, and building sectors. The selection of strategies on this list was informed by stakeholder and community feedback; the Cadmus Team's prior work with municipal governments nationwide; and desk research on the West Chester Area's state, utility, and local policy context, outlined in the Electricity Landscape section.

The Cadmus Team shared this initial list of strategy options with the Advisory Group members, which then conducted a prioritization exercise to select the top 18 strategies to analyze further. For each of the top 18 strategies, the Cadmus Team then qualitatively assessed and ranked each strategy on a scale of one (low) to three (high) against key criteria, summarized below:

- **Potential Scale of Impact**: Extent to which a strategy is expected to increase renewable energy supply in the electricity sector and/or increase the adoption of electrification technologies within the transportation or building sector within the West Chester Area.
- **Technical Feasibility**: Extent to which a strategy is feasible considering potential technical barriers (e.g. technology or policy).
- **Political Feasibility**: Extent to which a strategy is feasible considering local and state political barriers and social acceptability within participating municipalities.
- **Potential Financial Impact**: Extent to which a participating municipality will incur costs to implement the strategy.

For each strategy, the Cadmus Team also worked with the Advisory Group to identify key relevant examples in the West Chester Area or neighboring locales and categorized each strategy's implementation timeline as short- (0-1 years), medium (2-4 years), or long-term (5+ years). For more information on the top 18 strategies please see the strategy profiles below.

Energy and Financial Impact Modeling

The final component of the analysis involved quantitative energy and financial impact modeling. Of the 18 strategies identified as priorities in consultation with the Advisory Group, seven were deemed to have a minimal direct impact on the energy mix in the near-term. While these strategies play a key role in setting the foundation for future action, they are anticipated to have a minimal direct impact on the energy supply and therefore were not modeled.

The remaining 11 strategies were expected to have greater energy impacts. As such, the Cadmus Team modeled the likely energy impacts and calculated the approximate financial impacts each of these 11 selected strategies would have toward increasing the share of renewable energy in the West Chester Area's supply mix. Some considerations for each modeled strategy include:

- **Year Started**: The year in which a strategy is expected to begin affecting distributed generation buildout or the power supply to the townships.
- **Area of Impact**: Area in which a strategy impacts the electricity supply. Strategies either increase distributed generation in the townships directly or cause broader impacts to the power mix supplying the townships.
- **Scale of Impact**: Extent to which a strategy affects renewable generation and how large the impact is assumed to be per year.

For more information on the modeling methodology and assumptions, **please see Appendix C.**

Synthesized Findings for Analyzed Strategies

Based on the findings from the policy analysis and the results of the energy and financial impacts modeling work, four key categories emerged into which the 18 strategies can be divided depending on expected impact, local level of control, and overall role in the energy transition. These categories include 1) Enabling Strategies, 2) Community Engagement Strategies, 3) Municipal Supply Mix Strategies, and 4) State-Level Options.

Each of these categories and the associated strategies are explained in further detail in the following section. For each strategy, a one-page profile details information from the strategy analysis, including estimated energy impacts, technical feasibility, and political feasibility; as well as detailed implementation information, such as level of local control, timeline, implementation steps, and relevant resources and examples. The key below summarizes how to interpret the profiles:

Criteria	Description	Ranking
Potential Scale of Impact	Extent to which a strategy is expected to increase renewable energy supply in the electricity sector and/or increase the adoption of electrification technologies within the transportation or building sector within the West Chester Area.	**Low**: Action is expected to have minimal or no impact of the level of RE and/or adoption of electrification technologies in the West Chester Area.
		Medium: Action is expected to have a moderate impact on of the level of RE and/or adoption of electrification technologies in the West Chester Area.
		High: Action is expected to have a major impact on the level of RE and/or adoption of electrification technologies in the West Chester Area.
Technical Feasibility	Extent to which a strategy is feasible considering potential technical barriers (e.g. technology or policy).	**Low**: Action faces major technical barriers that jeopardize the action's ultimate implementation.
		Medium: Action faces moderate technical barriers, though these barriers are not considered fatal flaws.
		High: Action is expected to be

		implemented without significant technical complications.
Political feasibility	Extent to which a strategy is feasible considering local and state political barriers and social acceptability with participating municipalities.	**Low**: Action faces major political barriers and/or strong opposition from some stakeholders.
		Medium: Action faces moderate political barriers and no strong response from stakeholders.
		High: Action is expected to be implemented without significant political barriers and stakeholders are expected to be broadly supportive or ambivalent toward the action.
Local Level of Control	Extent to which a strategy is within a participating municipality's direct control.	**Low**: Action is outside of the direct control of a participating municipality
		Medium: Action is partially within the direct control of a participating municipality, but requires coordination with other entities (e.g. the utility)
		High: Action is within the direct control of a participating municipality
Timeline	Categorization of a strategy's implementation timeline.	**Short-Term**: 0-1 years
		Medium-Term: 2-4 years
		Long-Term: 5+ years

Category 1: Enabling Strategies

Overview

This category includes strategies that set the foundation for future action. Many of these strategies ensure alignment with current and future renewable energy technologies in order to reduce costs and policy barriers associated with renewable energy integration. These strategies are typically highly local and within the direct control of the municipality, but are not expected to have a substantial, direct impact on the energy mix. As such, these strategies have not been included in the energy and financial impact modeling work. Lastly, while WCA municipalities are expected to incur costs for staff-time to implement these strategies in the near-term, there is strong potential for these strategies to also generate financial benefits and job creation for WCA communities in the long-term. Key strategies in this category are listed below:

#	Strategy	Page
1.1	Encourage solar ready guidelines	20
1.2	Streamline interconnection processes	22
1.3	Pass EV-ready ordinances	24
1.4	Install public charging stations for EVs	26
1.5	Develop a building electrification roadmap	28

Strategy 1.1: Encourage Solar Ready Guidelines

Description: *Participating municipalities encourage new buildings to be built in a way that accommodates future solar installations*

Criteria	Ranking	Description
Potential Scale of Impact	LOW	Limited direct energy impacts expected as the strategy does not directly generate clean energy and is limited to the rooftop solar and new construction market. However, this strategy reduces technical and financial barriers to solar implementation and will thus play an important role in the West Chester Area achieving its full solar potential over the medium- to long-term.
Technical Feasibility	MEDIUM-HIGH	No major technical barriers expected given the Delaware Valley Regional Planning Commission's (DVRPC) existing guidelines. Additionally, several resources outlining best practices are available via SolSmart, National Renewable Energy Laboratory (NREL), and more. See below for more information on resources.
Political Feasibility	HIGH	No major political barriers expected. According to NREL, building owners and real estate developers stand to benefit from solar ready guidelines as it is a low-cost step that will position them to take advantage of lower costs of solar in the future.

Level of Local Control: Low | Medium | **High**

Timeline: **Short-Term** | Medium-Term | Long-Term

Financial Information	
Costs	Implementation costs are expected to be largely limited to staff time.

Implementation Steps		Resources and Examples
1.	Review template solar ready guidelines and adapt for WCA context, if needed	• DVRPC: Solar Ready New Construction Checklist • West Chester Borough: Green Building Certification Checklist • NREL: Solar Ready: An Overview of Implementation Practices

2.	Consider joining SolSmart for additional technical assistance related to best practices and implementation	• SolSmart: Technical Assistance

Strategy 1.2: Streamline Interconnection Processes

Description:

Interconnection is the process by which a new distributed energy generation resource such as a solar, wind or hydropower system, is connected to the utility's grid. Once a renewable energy project has been built, it can be interconnected in order to provide power to the grid. This interconnection enables off-takers from the project to receive credit for their project's energy contributions to the grid through a process called net metering (described in the Electricity Landscape section of this report). Interconnection requires approval from the utility and can involve a lengthy process, depending on whether any grid improvements are needed to support the additional load or the number of additional applications that are in the queue. Participating municipalities could collaborate with PECO to develop more transparent, standardized, and in some cases automated utility interconnection procedures.

Criteria	Ranking	Description
Potential Scale of Impact	LOW	Limited direct energy impacts expected as the strategy does not directly generate clean energy. However, this strategy reduces technical barriers to solar implementation and will thus play an important role in the West Chester Area achieving its full solar potential over the medium- to long-term.
Technical Feasibility	**MEDIUM**	Some technical barriers expected. Potential barriers may include municipal staff and community members needing to become more familiar with interconnection processes in order to engage effectively with the utility. Additionally, there may be barriers related to the need for infrastructure upgrades.
Political Feasibility	**MEDIUM**	There are no major political barriers expected. Addressing interconnection would likely generate support from homeowners and solar developers who wish to install solar. This strategy has the potential to strengthen the community's relationship with utility. While some homeowners and solar contractors have publicly published complaints about PECO's interconnection costs, streamlining the interconnection process could help realize a mutually beneficial arrangement for all parties involved.

Level of Local Control:

Low | **Medium** | High

Timeline:

Short-Term | **Medium-Term** | Long-Term

Financial Information	
Costs	Implementation costs are expected to be largely limited to staff time.
Savings	Strategy is expected to produce direct savings in the installation cost of residential solar at approximately $125 for an average 5 kW residential solar system. Note that this savings is reflective of the soft cost savings after the interconnection process has been streamlined.

Implementation Steps		Resources
1.	Review interconnection best practices; identify challenges and concerns regarding the existing interconnection process	• Interstate Renewable Energy Council: Model Interconnection Procedures
2.	Engage PECO and hold a collaborative discussion to discuss concerns and potential solutions. Set up a process for ongoing communication between PECO and the WCA.	• DVRPC & SolSmart: Addressing Solar PV Interconnection Challenges: Lessons for Local Governments and Utilities • Solsmart Toolkit for Local Governments: Utility Engagement
3.	Consider joining SolSmart for additional technical assistance related to best practices and implementation	• SolSmart: Technical Assistance

Strategy 1.3: Pass EV-Ready Ordinances

Description: *Participating municipalities encourage EV readiness measures in new construction and/or renovations of a certain level, including providing adequate electrical capacity to support EV charging or installing charging stations in a certain percentage of parking spaces.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	Strategy is not expected to increase the adoption of EVs in the near term since the strategy focuses on the new construction market and does not address the much larger share of existing buildings. Voluntary measures will also have a lesser impact than mandated ones. However, increased access to charging infrastructure in all new construction will help reduce range anxiety and encourage EV adoption in the medium to long-term as additional new development occurs.
Technical Feasibility	HIGH	No major technical barriers expected. Additionally, there are several resources outlining best practices via the Alternative Fuels Data Center.
Political Feasibility	MEDIUM	No major political barriers expected as EV ready ordinances are a suggested strategy in the PA Electric Vehicle Roadmap. Level of political feasibility may vary depending on local interest in voluntary options (like current West Chester example) as opposed to mandates. Developers might push back on having to comply with new EV Ready codes if they are mandated.

Level of Local Control: Low | Medium | **High**

Timeline: **Short-Term** | Medium-Term | Long-Term

Financial Information	
Costs	Implementation costs to pass the ordinance are expected to be largely limited to staff time.

Implementation Steps		Resources and Examples
1.	Develop EV-Ready voluntary codes, zoning ordinances, or parking requirements	• Alternative Fuels Data Center: Pennsylvania EV Roadmap • City of Atlanta, GA: EV Ready Ordinance
2.	Implement the new methods to support EV Readiness	• City of Richmond, BC: Residential EV Charging, A Guide for Local Governments

Strategy 1.4: Install Public Charging Stations for EVs

Description: *Participating municipalities build out EV charging infrastructure in publicly owned buildings, parking lots, or in the right-of-way.*

Criteria	Ranking	Description
Potential Scale of Impact	**MEDIUM-HIGH**	Strategy is expected to increase the adoption of electric vehicles in the West Chester Area. A noted barrier to entry in the PA Electric Vehicle Roadmap is access to charging infrastructure for residents without a garage or dedicated parking.
Technical Feasibility	**MEDIUM**	Strategy is expected to face moderate technical barriers as adequate electrical infrastructure is necessary to support charging. Adding electrical capacity can potentially be an expensive, time consuming, and disruptive process.
Political Feasibility	**MEDIUM**	Little political and stakeholder opposition is expected as public chargers are already a common topic of discussion across the municipalities. One potential point of contention is determining the source of funding as charging infrastructure has high upfront costs. Another contentious topic may be the impact on available parking. If space for parking is already constrained, designating some parking spots as "EV only" might incur pushback.

Level of Local Control: Low | Medium | **High**

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Costs	Implementation costs include staff time, as well as upfront costs for infrastructure and installation. Costs for infrastructure, installation, and network services vary (see NYSERDA Best Practices Guide and US Department of Energy [DOE] Report below for more information).

Implementation Steps		Resources
1.	Identify potential sites in municipal lots and/or right of way spaces for public charging stations	• NYSERDA: Best Practices for Charging Stations • City of Richmond, BC: Electric Vehicle Charging Infrastructure in Shared Parking Areas: Resources to Support Implementation & Charging Infrastructure Requirements • PA Department of Environmental Protection (DEP): VW Settlement Funds • US DOE Costs Associated with Non-Residential Electric Vehicle Supply Equipment
2.	Analyze the sites to determine electrical upgrade requirements and potential utilization rates; possibly connect with local utility for site analysis	
3.	Conduct an economic analysis to determine final list of sites	
4.	Apply for known grants or consider other funding sources to help offset expected upfront costs	
5.	Work with a vendor to determine best business model and begin installation	

Strategy 1.5: Develop a Building Electrification Roadmap

Description: *Participating municipalities create a plan to guide building electrification efforts, including policy and program recommendations, near and/or long-term targets for building electrification, and metrics for success.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	Strategy is expected to indirectly support the adoption of building electrification technologies over time as a roadmap is a vital first step towards building electrification by organizing and guiding municipal efforts. While strategy is not expected to have a major impact on technology adoption in the near-term, it plays an important role in the overall transition to 100% RE.
Technical Feasibility	MEDIUM	Some barriers are expected including the need for greater state and local expertise in the building sector. However, several municipalities in a similar climate have made building electrification plans that the municipalities can use as a guide for their own plan, where publicly available.
Political Feasibility	MEDIUM	Creating the building electrification roadmap itself is not anticipated to face significant political barriers. However, generating buy-in from municipal partners in the roadmap creation and in implementing policy and program recommendations could face substantial political challenges. Some stakeholders may push to slow electrification below what is necessary to achieve RE goals, citing high costs of replacing fossil fuel systems. Municipalities can work to build stakeholder and public buy-in by citing electrification benefits, including improved indoor air quality, improved home comfort, and lower emissions.

Level of Local Control: Low | Medium | **High**

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information

Implementation costs are expected to be largely limited to staff time, but may expand to include hiring technical support for some and/or all aspects of the roadmap.

Implementation Steps		Resources
1.	Conduct baseline analysis to evaluate local building electrification market conditions (existing building stock, economics of heat pumps for different building-types, state-level policy and regulatory conditions, and major local supply chain players).	• Building Decarbonization Coalition: A Roadmap to Decarbonize California Buildings • Burlington Electric Department: Net Zero Energy Roadmap for the City of Burlington, Vermont • Rocky Mountain Institute: The Economics of Electrifying Buildings
2.	Engage relevant state-level decision-making bodies (e.g. PA DEP, PA Public Utilities Commission, and PECO) to evaluate their capacity and willingness to support building electrification. Engagement may be individual or collectively through a working group or workshop.	
3.	Compile analysis and potential conversations into an actionable building electrification roadmap.	

Category 2: Community Engagement Strategies

This category includes strategies that generate awareness of renewable energy and electrification options, and provide opportunities for residents, local businesses, and other stakeholders to engage in the process. These strategies are generally within the direct control of the municipalities, but are not expected to have a substantial, direct impact on the energy mix. As such, these strategies have not been included in the energy and financial impact modeling work, with the exception of Strategy 2.2. Lastly, while WCA municipalities are expected to incur costs for staff-time to implement these strategies in the near-term, there is strong potential for these strategies to also generate financial benefits and job creation for WCA communities in the long-term. Key strategies in this category are listed below:

Strategy 2.1: Initiate Renewable Energy Educational Campaigns

Description: *Participating municipalities develop educational campaigns to create community support for RE strategies and to encourage voluntary action at an individual or private business level. A campaign may be led by a municipality directly or could provide funding to another organization that has complementary expertise, for example in community outreach.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW	This strategy is not expected to directly increase the amount of RE in the West Chester Area's energy supply in the near-term as is does not directly generate clean energy. However, it may have a greater impact on renewable energy supply in the long-term by increasing local awareness of the benefits of RE and lowering existing political barriers surrounding the implementation of RE in the area. The scale of impact may be slightly larger if the campaign is executed at the COG or County-level.
Technical Feasibility	HIGH	Strategy is not expected to face major technical barriers given the efforts already in place in the West Chester Area and the number of resources available to support implementation.
Political Feasibility	MEDIUM-HIGH	An educational program that has little costs and places little burden on staff is anticipated to have political support. However, strategy may face limited opposition from some stakeholders who do not support using municipal funds for RE outreach.

Level of Local Control: Low | Medium | **High** (selected: High)

Timeline: **Short-Term** | Medium-Term | Long-Term (selected: Short-Term)

Financial Information	
Costs	Implementation costs are expected to be largely limited to staff time.

Implementation Steps		Resources
1.	Review existing educational materials and adapt to the WCA context, if needed.	• Chester County Ready for 100 Team: Chester County Clean Energy Tour Program

2.	Hold public educational events and share information via community outreach on potential opportunities for businesses and residents to participate municipality RE plans.	• West Chester Area Council of Governments: West Chester Area Renewable Energy Transition Project Site • Sierra Club: 100% Clean Energy School Districts Campaign Organizing Toolkit

Strategy 2.2: Establish and/or Participate in Group Purchasing Campaigns

Description: *Host or support group purchasing programs for renewable electricity (e.g. Solarize campaigns) to reduce costs and support market development.*

Criteria	Ranking	Description
Potential Scale of Impact	**MEDIUM**	By reducing upfront costs and providing education, this strategy will reduce barriers to distributed renewable energy generation, but is not expected to have a major impact on the West Chester energy mix in the near-term. However, it should be noted that it is possible for this strategy to have greater reach with a higher level of investment from the participating municipality(s). Campaigns can be undertaken repeatedly to increase participation and reach of the program.
Technical Feasibility	**MEDIUM**	Strategy is not expected to face major technical barriers, given their prevalence and success in similar locations across the US, as well as current action being taken in the West Chester Area. Furthermore, there are a number of existing resources on group purchasing campaigns, especially throughout New England and the Northeast, and the number of Pennsylvania campaigns has grown in recent years. Potential technical barriers to the success of a group purchasing campaigns may include interconnection challenges.
Political Feasibility	**MEDIUM-HIGH**	No major political barriers expected given current action in the West Chester Area. Additionally, the community education and engagement components of group purchasing are expected to reduce any opposition from stakeholders.

Level of Local Control: Low | Medium | **High**

Timeline: **Short-Term** | Medium-Term | Long-Term

Financial Information	
Costs	Implementation costs are expected to be largely limited to staff time to select a non-profit partner to run program, coordinate action with nonprofit, and conducting outreach in community for solarize program

Implementation Steps		Resources and Examples
1.	Research the process for developing a group purchasing campaign and train staff as needed.	• Solarize Southeast PA: Overview • Solarize Northern Virginia (NOVA): Overview • National Renewable Energy Laboratory: The Solarize Guidebook
2.	Develop a team to support campaign activities, including city staff and/or community volunteers. Staff responsibilities include program coordination, marketing, and installer and utility relations.	
3.	Issue a request for proposals (RFP) for installers, evaluate responses, and select an installer.	
4.	Promote the campaign through community outreach.	

Strategy 2.3: Engage the Community in Setting Energy Goals

Description: *Convene, facilitate, and/or support on-going public discussions with the community around energy goals and/or encourage local businesses and institutions to set renewable electricity goals of their own.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW	Although engaging the community around energy goals is unlikely to directly result in a large number of RE installations, such a strategy promotes awareness among community members, increases resident buy-in to the other proposed RE strategies, and encourages voluntary action at an individual or private business level. Furthermore, municipalities could encourage local businesses and institutions to develop RE goals of their own.
Technical Feasibility	**MEDIUM-HIGH**	No major technical barriers expected given the history of action in the West Chester Area. However, the community engagement process may affect the timeline to implement renewable energy strategies as it will lengthen the time needed to develop plans and policies. Engaging the community will also require staff time to implement.
Political Feasibility	**MEDIUM-HIGH**	An engagement program that is relatively low cost and places little burden on staff is anticipated to have political support.

Level of Local Control: Low | Medium | **High**

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Costs	Implementation costs are expected to be largely limited to staff time.

Implementation Steps		Resources
1.	Develop a plan to optimize community engagement, drawing upon best practices on clean energy program design.	• Urban Sustainability Directors Network: A Guidebook on Equitable Clean Energy Program Design for Local Governments and Partners • Rocky Mountain Institute: Community Energy Resource Guide
2.	Create opportunities for public engagement throughout the WCA and clearly indicate how public engagement will be factored into final goals, plans, and policies.	
3.	Advertise the opportunities through community outreach. Incentivize and encourage ongoing community development	

Strategy 2.4: Initiate Renewable Heating and Cooling Marketing Campaigns

Description: *Establish and/or strengthen marketing, educational, and group purchasing campaigns to raise awareness and expand implementation of building electrification technologies.*

Criteria	Ranking	Description
Potential Scale of Impact	**MEDIUM**	Strategy is expected to reduce barriers to building electrification in the near-term and increase adoption of renewable heating and cooling technologies. The success of these programs in encouraging adoption of electrification technologies has varied by municipality, but it is generally limited to a subset of homes and businesses that opt-in to building electrification instead of widespread adoption or market transition. Leve of uptake will vary based on existing heating fuel type for existing homes and businesses.
Technical Feasibility	**MEDIUM**	Strategy is expected to face some technical barriers given the lack of experience hosting these types of campaigns. Municipal staff may need to be trained in specialized content related to electrification technologies or installer recruitment. Participating municipalities could consider leveraging lessons learned and key takeaways from past campaigns in New York and Massachusetts or local Solarize campaigns to decrease these challenges.
Political Feasibility	**MEDIUM**	Strategy is expected to face moderate political and stakeholder opposition. In some cases, stakeholders may question the technologies or be reluctant to switch from traditional fuels.

Level of Local Control: Low | Medium | **High** (selected: High)

Timeline: **Short-Term** | Medium-Term | Long-Term (selected: Short-Term)

Financial Information	
Costs	Implementation costs will include staff time, as well as costs for marketing materials. Additional costs may include rebates for customers, should they be incorporated into the program.

Implementation Steps		Resources and Examples
1.	Research the process for establishing a marketing campaign, train staff as needed.	• Meister Consultants Group: Key Findings from Pilot Renewable Heating and Cooling Campaigns • Clean Energy States Alliance: Community Campaigns for Renewable Heating and Cooling Technologies - Case Studies
2.	Develop a team to support campaign activities.	
3.	Issue a request for proposals (RFP) for HVAC installers, evaluate responses, and select an installer.	
4.	Promote the campaign through community outreach in conjunction with installers	
5.	Manage incoming leads and updates leads over time and collect participation metrics to determine program efficacy and use to apply for funding for future campaigns.	

Category 3: Municipal Supply Mix Strategies

Strategies in this category allow the municipalities to lead by example by taking direct action to increase the renewable share of the municipal energy mix (e.g. energy that supplies local government operations). These strategies are within the direct control of the municipality and can have a substantial impact on municipal operations. However, they will have a more limited impact on the community-wide energy mix. Key strategies in this category are listed below:

Strategy 3.1: Install Renewable Energy On-Site to Supply Municipal Operations

Description: *Install renewable energy projects on municipal facilities and land to power municipal operations with renewable electricity. The municipality could directly own the installation or consider a third-party ownership model via a solar lease or power purchase agreement (PPA).*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	This strategy is not expected to greatly increase the amount of RE in the West Chester Area's energy supply as municipal facilities may be limited in on-site space to host RE projects. Additionally, municipal facilities account for a small percentage of the West Chester Area's building and land stock. Impact could be increased by encouraging other entities, such as the County government, school districts, or large commercial customers to install RE on-site via education, outreach, and the improvement of local processes (e.g. streamlined permitting, inspection, and zoning).
Technical Feasibility	MEDIUM	Strategy is not expected to face major technical barriers given the history of action in the West Chester Area. Potential technical barriers may include interconnection challenges and site-specific barriers (e.g., shading, roof age, etc.).
Political Feasibility	MEDIUM-HIGH	Strategy is not expected to face major political barriers given history of action in the West Chester Area. Strategy may face opposition from some stakeholders who do not support using city funds to install RE; however, these barriers could be reduced by on-going education and outreach on the benefits of RE, including long-term cost savings.

Level of Local Control: Low | Medium | **High**

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Option 1: Own and Install System	Costs include staff time to select and coordinate with an installer. The system would require an upfront cost of $2.1/watt, for a total of ~$171,000 per 81.5 kW of installed solar, the assumed average solar potential for municipal buildings in the WCA. Net metering savings from an 81.5 kW system are estimated at ~$5,700 per year.
Option 2: to Lease Panels and Establish PPA	Costs include staff time to select and coordinate with an installer. At a fixed price PPA rate of $0.06/kWh, an 81.5 kW solar PV array would add an additional cost of $300 per year.

Implementation Steps		Resources
1.	Identify potential sites for solar installation	• SolSmart: Guide to Implementing Solar PV for Local Governments
2.	Conduct technical and economic feasibility analysis for each site, considering financing options and available incentives, and select a site	
3.	Determine preferred ownership model and issue an RFP or contact solar installers directly to receive proposals	• US Environmental Protection Agency (EPA): Solar Project Development Pathway and Resources
4.	Review proposals, award bid, and construct systems	

Strategy 3.2: Procure Renewable Energy from Retail Electricity Providers

Description: *Purchase electricity from a competitive supplier to supply municipal operations with renewable energy.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	This strategy would enable a participating municipality to supply municipal operations with up to 100% renewable energy. According to the Pennsylvania Power Switch website, there are a number of suppliers currently offering green products with varying percentages of renewable energy in the PECO service territory. Impact is limited as municipal operations constitute a limited percentage of community-wide consumption.
Technical Feasibility	HIGH	Strategy is not expected to face major technical barriers given available resources, such as the PA Power Switch website and resources available via the PA Municipal Utility Alliance. Some minor technical barriers may include the need for staff to be trained in specialized content and constraints related to duration of existing contracts.
Political Feasibility	MEDIUM	Strategy is not expected to face major political barriers given history of action in the West Chester Area. However, strategy may face limited opposition from some stakeholders who do not support using city funds to purchase RE.

Level of Local Control: Low | Medium | **High**

Timeline: **Short-Term** | Medium-Term | Long-Term

Financial Information	
Costs	Annual costs are associated with selecting a 100% renewable electric supplier with an increased cost equal to Tier 1 PA renewable energy certificates (RECs). This would include a rate increase of $0.006/kWh for municipal facility electric costs, or approximately $135,500 across all six township municipal facilities.

	Implementation Steps	Resources
1.	Identify electricity suppliers serving the West Chester Area and research their renewable energy offerings	• PA Power Switch: Electric Shopping Platform • PA Power Switch: How to Shop and Switch Electricity in PA
2.	Compare supplier offerings, noting the pricing, fees, contract length, and percentage of renewable energy	
3.	Select a supplier and contact to enroll in their retail program offering	

Strategy 3.3: Power Purchase Agreement: Partner with a Third Party to Procure Renewable Energy

Description: *Participating municipality(s) partner with an independent power producer (IPP) to procure renewable electricity for municipal operations through a power purchase agreement. There are multiple strategies for entering into a power purchase agreement, including a physical PPA versus a virtual PPA. For the purpose of this analysis, the Project Team focused on physical PPAs for offsite renewables.*

Criteria	Ranking	Description
Potential Scale of Impact	**LOW-MEDIUM**	This strategy would enable a participating municipality to supply municipal operations with greater percentages of renewable energy. However, impact is somewhat limited given the space available within the PECO service territory for large RE developments.
Technical Feasibility	**MEDIUM-HIGH**	Strategy is not expected to face major technical barriers given nearby examples with processes and lessons learned that can by leveraged in the WCA. Some technical barriers may include the need for staff to be trained in specialized content related to RE procurement.
Political Feasibility	**MEDIUM-HIGH**	Strategy may face some opposition from stakeholders who oppose use of municipal resources to support RE purchases. These barriers may be mitigated by educating stakeholders about the potential benefits, including decreased electricity costs.

Level of Local Control: Low | Medium | **High**

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Costs	Costs include time spent selecting and contracting a PPA and coordinating potential C&I participation.
Savings	Electricity costs would decrease by $0.0125/kWh through the fixed price PPA rate for municipal facility energy use. This corresponds to savings of approximately $274,000 annually across all six township municipal facility bills.

Implementation Steps		Resources and Examples
1.	Identify independent power producers (IPPs) within PECO territory.	• Environmental Protection Agency: Physical Power Purchase Agreements • NREL: Power Purchase Agreement Checklist for State and Local Governments • Center for Climate and Energy Solutions: How Cities Benefit from Power Purchase Agreements • City of Philadelphia: Solar Power Purchase Agreement with Community Energy
2.	Negotiate and enter contract with the IPP, ensuring RECs will be conveyed to the participating municipalities.	
3.	IPP builds, maintains, and continues to operate the RE system, while the municipalities receive title to the electricity and RECs.	

Strategy 3.4: Purchase Renewable Energy Certificates (RECs)

Description: *Purchase RECs to realize local energy targets. Participating municipalities could also provide information to residents and businesses to support them with the potential purchase of RECs.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	Strategy is expected to have a substantial impact on the West Chester Area's energy mix, as purchasing RECs could potentially cover a municipality's entire RE target. It is important to note that local benefit will be dependent on where the RE projects that generate the RECs are located and if the REC purchases spur additional RE development.
Technical Feasibility	HIGH	Strategy is not expected to face technical barriers given the history of action in the West Chester Area and presence of established REC markets. Additionally, a number of resources explaining REC purchases are publicly available, such as the EPA's Guide to Purchasing Green Power.
Political Feasibility	LOW-MEDIUM	Strategy may face some opposition from stakeholders who oppose the use of municipal funds to support RE purchases.

Level of Local Control:

Low | Medium | **High**

Timeline:

Short-Term | Medium-Term | Long-Term

Financial Information	
Costs	Costs include the annual cost to purchase RECs to cover municipal energy use, estimated in 2035 when REC purchases cover the difference between baseline renewable supply and 100% of municipal facility electricity. Costs to purchase PA Tier 1 RECs for all six townships are estimated at $129,000 per year, and costs to purchase TX wind RECs for all six townships are estimated at $16,000 per year.

	Implementation Steps	Resources
1.	Determine the number of RECs the city needs to purchase by subtracting the percentage of electricity generated by renewable sources from the current renewable energy target and multiplying by annual electricity usage	• Environmental Protection Agency: Guide to Purchasing Green Power • Green-e: Certified Green Power • Evolution Markets: REC Trading 101
2.	City staff contact a competitive electricity supplier and request they buy RECs on the municipality's behalf to meet the current energy target, updating REC needs on an annual basis.	
3.	Alternatively, city staff contact a renewable energy broker (e.g., Evolution Markets) and coordinate REC purchase through broker, updating REC needs on an annual basis.	

Strategy 3.5: Lead by Example in Building Facilities (Building Electrification)

Description: *Participating municipalities establish "lead by example" programs to design and implement electrification projects and retrofit strategies in public facilities.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	Lead by example projects are not expected to have a major direct impact on technology adoption in the near-term. However, this strategy is expected to support the adoption of building electrification technologies by improving awareness of renewable thermal systems and supporting market development.
Technical Feasibility	MEDIUM	Technical feasibility will vary significantly by building/facility, and implementation timeline will vary based on when existing systems are due for replacement. The resources section below provides case studies of different building types that have been successfully electrified. Generally, GSHPs are the most applicable for larger facilities that have open space surround them (e.g., large parking lots). ASHPs or VRFs are most applicable for municipal buildings that that currently lack central cooling and could benefit from heat pump technologies to improve occupant comfort.
Political Feasibility	MEDIUM-HIGH	Strategy is expected to face some political and stakeholder opposition, particularly regarding the source of funding for implementing upgrades. Renewable thermal systems have high upfront costs and can have higher operating costs than gas heating systems. However, emphasizing "high-efficiency heating and cooling" will be important, and sourcing rebates from PECO or the Commonwealth of Pennsylvania should help reduce the political barriers related to high perceived costs.

Level of Local Control: Low | Medium | **High**

Timeline: **Short-Term** | Medium-Term | Long-Term

Financial Information	
Heat Pump Water Heater and VRF Heat Pump Systems	Costs for a typical municipal building in the WCA could include approximately $100,000 in capital costs and annual operating costs of $9,800. Operating costs include current electricity usage and the new electricity usage for heat pump systems.
Natural Gas Heating Unit	Costs for a typical building in the WCA include approximately $43,000 in capital costs and annual operating costs of $10,200. Operating costs include current electricity usage and gas for heating based on the typical building. As a note, operating costs do not include the costs of cooling building, which does not currently appear to have a cooling system. Gas system capital cost would increase significantly to cover the cost of adding central cooling to the building, whereas VRF system provides both heating and cooling in one system

Implementation Steps		Resources
1.	Conduct inventory of existing building heating systems to identify buildings that have heating systems that will require replacement in the near-term (0-2 years).	• Metropolitan Area Planning Council: Hot, Clean, Cool • Marc Rosenbaum, P.E. at Energysmiths: Prototype Classroom – A Deep Energy Retrofit at the Plainfield, NH School • U.S. Green Building Council: Zero Energy Buildings in Massachusetts • Northeast Sustainable Energy Association: Bennington Superior Courthouse and State Office Building
2.	Perform high-level cost-benefit analysis to evaluate the economics of installing building electrification technologies to further prioritize buildings for upgrades. Concurrently, evaluate municipal capacity for financing upgrades.	
3.	Identify and conduct outreach to renewable thermal installers in the area to further evaluate the financial and technical feasibility of building electrification upgrades.	
4.	Finalize and complete prioritized building electrification installations.	

Strategy 3.6: Procure Electric Vehicles for Municipal Fleet

Description: *Participating municipalities can integrate EVs as part of their municipal fleets. This may also include efforts to electrify school bus fleets, and/or support electrification of transit bus fleets if not owned/controlled by the municipality.*

Criteria	Ranking	Description
Potential Scale of Impact	LOW-MEDIUM	Procuring Electric Vehicles for Municipal Fleets will increase overall public exposure and visibility of EVs, and demonstrate leadership by example. The size and scope of municipal fleets are limited though and only account for a small percentage of vehicles in the area.
Technical Feasibility	LOW-MEDIUM	Strategy is not expected to face major technical barriers as the technology exists and other cities have implemented similar strategies. The primary technical concern will be building adequate charging infrastructure to support these electric fleets.
Political Feasibility	MEDIUM	This strategy has the potential to mark municipalities as leaders in this space and demonstrate actionable measures taken to increase electrification. EV procurement is a high initial cost and moderate time commitment strategy to implement though as it will require tangential electrical infrastructure buildout. But given the smaller size of the municipal fleet, this has the potential to be easier. Strategy could face opposition from stakeholders who oppose using municipal funds and staff time to plan and design the infrastructure support and procure EVs that adequately support current needs.

Level of Local Control:

Low | Medium | **High**

Timeline:

Short-Term | Medium-Term | Long-Term

Financial Information	
Costs	Costs include staff time spent on EV procurement. The difference in municipal total cost of ownership for single EV over a current standard internal combustion engine vehicle is approximately $11,000 in 2020 and $6,000 in 2050.
Savings	Average fuel savings for an EV are approximately $1,000 per vehicle per year.

Implementation Steps		Resources and Examples
1.	Identify the size, age, and duty cycle of the municipal fleets	• Alternative Fuels Data Center Municipalities Case Studies • Climate Mayors: Electric Vehicle Purchasing Collaborative • EV Smart Fleets Initiative: Public Sector Fleet EV Procurement Examples
2.	Apply for local/state grants and incentives where applicable	
3.	Develop a procurement schedule based on the expiration of the current fleet, and needs for the vehicles	
4.	Set up long term procurement contract with vendor	
5.	Plan and design necessary charging infrastructure to support the changing fleet	

Category 4: State Level Options

This category includes changes to state policies that are expected to have a significant impact on the local energy mix. While municipalities do not have direct control over the implementation of these strategies, they can continue to engage with state-level actors to support policies that will help them accomplish comprehensive change. Key strategies in this category are listed below:

Strategy 4.1: Allow for Community Solar

Description: *The State enacts legislation that allows for community solar in Pennsylvania.*

Criteria	Ranking	Description
Potential Scale of Impact	MEDIUM	Allowing community solar in Pennsylvania is expected to increase the renewable energy supply within the West Chester Area in the medium- to long-term. Moreover, this strategy will increase access to solar for certain segments of the population who do not have equitable access to rooftop solar PV, such as renters, LMI households, or those with roofs unsuitable for solar. Overall impact will depend on the number and size community solar projects open for participation.
Technical Feasibility	MEDIUM	Executing community solar legislation would represent a significant policy at the state level. Specific technical barriers to engaging from the municipal level may include the need for staff to be trained in specialized content in order to support state legislation.
Political Feasibility	MEDIUM	Strategy may face opposition from some stakeholders who oppose the use of municipal staff time and resources to support state level legislation related on accelerating renewable generation, and may perceive this action as too advocacy oriented. The need for significant state-wide policy change also poses a barrier.

Level of Local Control: **Low** | Medium | High

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Costs	Costs depend on the implementation method used and the role the municipality plays. Potential costs include staff time spent doing outreach, coordinating community action and executing the municipality's share of the project.
Savings	Potential ongoing savings include an approximately 10% reduction in electricity price per kWh of community solar paid to utility.

	Implementation Steps	Resources
1.	Review proposed legislation regarding community solar and assign staff to track legislation progress	• PA General Assembly: House Bill 531 • PA General Assembly: Senate Bill 705
2.	Conduct outreach and education to encourage community members to advocate for community solar legislation; encourage outreach to elected representatives and electricity providers	• Coalition for Community Solar Access: Resources • Solar Energy Industries Association: Community Solar

Strategy 4.2: Allow for Community Choice Aggregation

Description: *The State enacts legislation that allows for community choice aggregation in Pennsylvania.*

Criteria	Ranking	Description
Potential Scale of Impact	HIGH	Enabling CCA is expected to increase the renewable energy supply within the West Chester Area in the medium- to long-term. CCA's allow communities to have greater control over their electricity sources and to negotiate better electricity rates.
Technical Feasibility	MEDIUM	Executing CCA legislation would represent a significant policy at the state level. Specific technical barriers to engaging from the municipal level may include the need for staff to be trained in specialized content in order to support state legislation, particularly given that CCA policy and design involves a relatively high level of technical policy background.
Political Feasibility	MEDIUM	Strategy may face opposition from some stakeholders who oppose the use of municipal staff time and resources to support state level legislation related to RE and may perceive this action as too advocacy oriented. Furthermore, in 2011, the PA PUC expressed concern regarding the potential negative impacts of municipal aggregation, including limited competition and innovation among suppliers.

Level of Local Control: **Low** | Medium | High

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Municipal Costs	Costs include initial staff time to establish the CCA, including time researching, advocating for statewide legislation, and passing a local law. Once established, a CCA would increase in electricity price by $0.006/kWh, for a total increase of approximately $137,500 annually across all six townships' municipal electricity consumption. Note that it is possible that renewable energy costs will continue to decline over time, in which case the expected costs to implement this strategy could be lower than projected here.
Residential Costs	Costs include an increase in electricity price of $0.006/kWh, or a total increase of approximately $40 annually per household.

<table>
<tr><th colspan="2">Implementation Steps</th><th>Resources and Examples</th></tr>
<tr><td>1.</td><td>Train staff on CCA, including review of legislation and programs in other states that have enabled CCAs.</td><td>• Environmental Protection Agency: Community Choice Aggregation
• EnergySage: States with Approved CCA Legislation</td></tr>
<tr><td>2.</td><td>Identify key partners to create an advocacy group and support legislation or progress toward developing CCA opportunities statewide</td><td rowspan="3">• California Community Choice Association: CCA Resources
• New York State Energy Research and Development Authority: Community Choice Aggregation</td></tr>
<tr><td>3.</td><td>Raise awareness through community outreach and education; encourage contacting legislators and utilities asking to support CCA legislation</td></tr>
<tr><td>4.</td><td>Upon passage of statewide CCA legislation, hold public hearings and pass a local law authorizing a CCA</td></tr>
</table>

Strategy 4.3: Increase the Alternative Energy Portfolio Standard

Description: *The State enacts legislation increasing utility commitments for renewable energy purchasing.*

Criteria	Ranking	Description
Potential Scale of Impact	HIGH	An increase in Pennsylvania's Alternative Energy Portfolio Standard (AEPS) is expected to have a significant impact on the energy mix in the West Chester Area. A higher standard would require utilities to increase their renewable sources, promoting clean energy use in consumer buildings. According to the National Conference of State Legislatures, "roughly half of the growth in US renewable energy generation since 2000 can be attributed to state renewable energy requirements." The specific level of gains would depend on the level defined in the legislation.
Technical Feasibility	MEDIUM	Pennsylvania's AEPS currently requires 18% of electricity come from alternative-energy resources by 2020. There is a significant gap between the current policy and an RPS that would align with 100% RE goals. Limited technical barriers exist related to municipal involvement. Some minor barriers may include the need for staff to be trained in specialized content in order to collaborate on action related to state legislation. Many states have mandates between 10 and 45%, and seven states have requirements set at 50% or more.
Political Feasibility	LOW-MEDIUM	An increase in PA's RPS requires action on the state-level. Significant opposition to the measure overall as well as to the engagement of West Chester municipalities would be expected, for example from stakeholders such as utility companies and those against mandatory measures.

Level of Local Control: **Low** | Medium | High

Timeline: Short-Term | **Medium-Term** | Long-Term

Financial Information	
Costs	Initial costs would include staff time spent researching, advocating for an increased AEPS, and conducting community outreach. Upon enacting and meeting an increased AEPS, electricity costs are anticipated to increase by $0.02/kWh, or $11 per month for the average residential household. Note that it is possible that renewable energy costs will continue to decline over time, in which case the expected costs to implement this strategy could be lower than projected here.

Implementation Steps		Resources and Examples
1.	Train staff and review existing legislation establishing the AEPS	• PA General Assembly: Alternative Energy Portfolio Standards Act - Enactment • PA Public Utilities Commission: AEPS Act Implementation Order • PA State Senate: Memorandum on Modernizing Pennsylvania's Renewable Energy Standards • State of Oregon: Renewable Portfolio Standard
2.	Identify key partners to create or support an advocacy group in favor of increasing the AEPS	
3.	Raise awareness through community outreach and education; encourage contacting legislators to support increasing the AEPS	
4.	PA General Assembly passes legislation increasing the AEPS, and local utilities develop plan and resources to meet mandate	

Summary of Modeling Findings

Figure 6 below outlines the West Chester Area's projected electricity demand through 2050 and the anticipated impact of strategies on the share of renewable energy. This impact has been displayed for select strategies that are expected to drive substantial increases in the level of renewables.

Note that the two dotted lines in Figure 6 represent the West Chester Area's forecasted electricity demand of the communities of the six townships assuming two different levels of energy efficiency. Notably, increased energy efficiency measures taken by the townships counteracts the increase in demand expected due to increases in electrification and population. The distinctions between the two lines are further described below:

- The black dotted line represents forecasted electricity generation required to meet the total community demand accounting for the intrinsic energy efficiency projections from the U.S. Energy Information Administration (EIA). These projections are pulled from the 2019 U.S. EIA Annual Energy Outlook.
- The green dotted line represents forecasted electricity generation required to meet the community demand accounting for EIA energy efficiency projections and an additional 15%[25] of energy efficiency gains due to potential energy efficiency actions in the West Chester Area.

[25] The number selected for energy efficiency should be interpreted as a placeholder. Indeed, it could be lower or higher depending on the time and resources invested towards energy efficiency measures. Potential high-level strategies for energy efficiency are noted in Appendix D. The placeholder value was selected to be realistic and as referenced it aligns with Boise, Idaho's energy plan. https://www.cityofboise.org/media/7676/ef-report.pdf

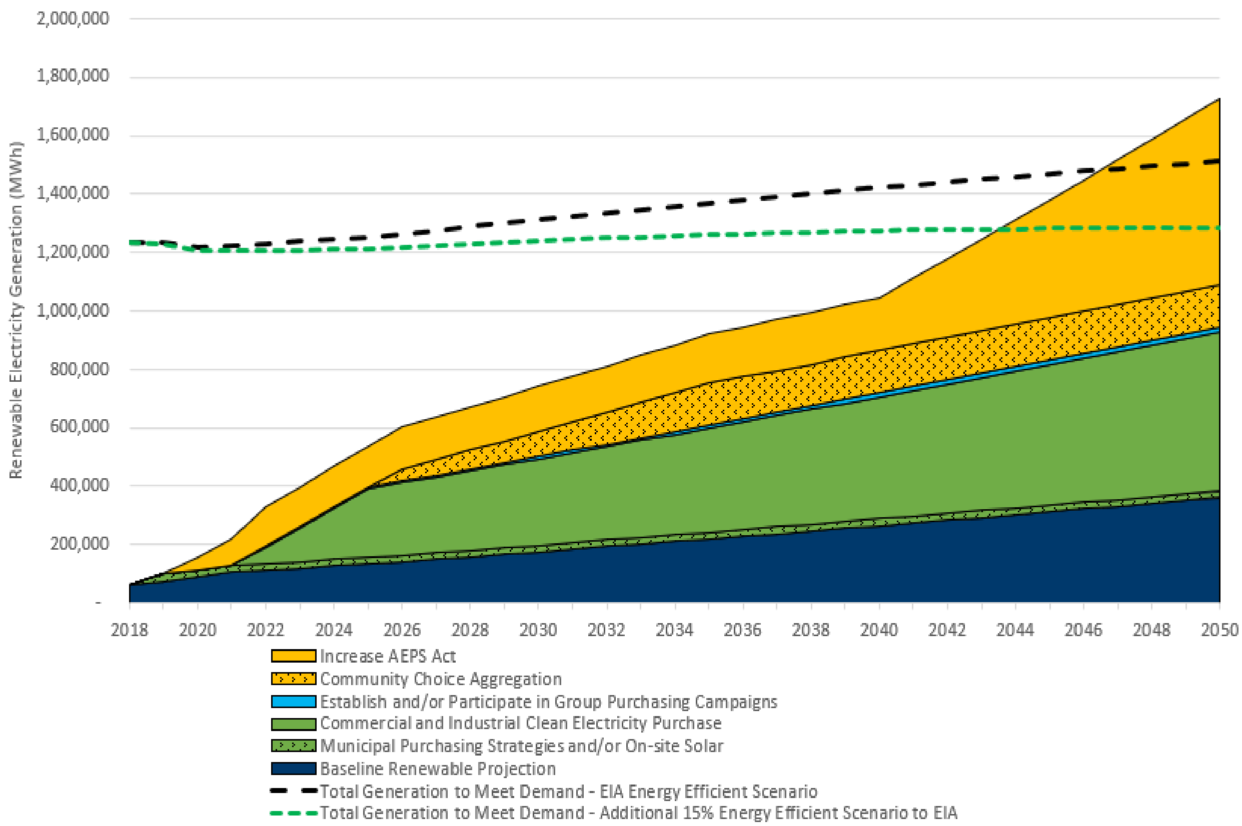


Figure 6: Projected Power Mix by Year: Effect on Renewable Share by Strategy Type[26]

Key takeaways based on the modeling outputs include:

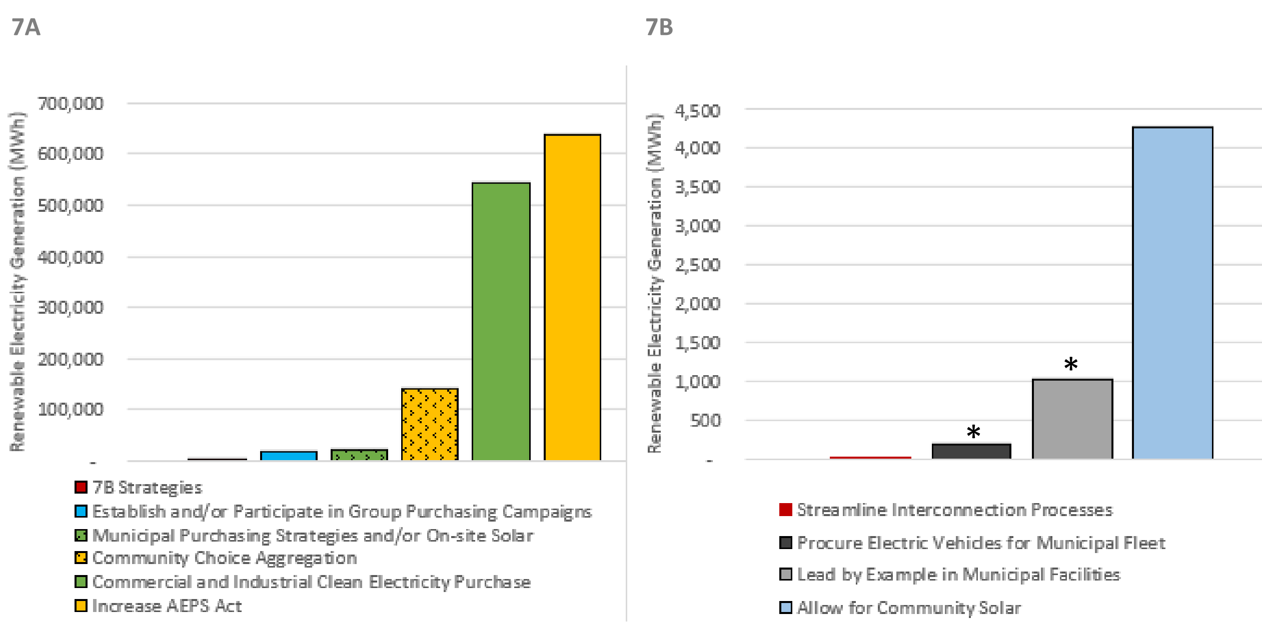
- In Figure 6, per our assumptions, the West Chester Area's electricity demand will be met by 100% renewable sources by 2043 and 2047 if all strategies are implemented for cases with and without additional efficiency measures by the townships, respectively.
- As shown in the stacked individual projected impacts of each policy in Figure 6, the strategies having the greatest effect on increasing renewable generation are establishing a community choice aggregation program, coordinating clean electricity purchasing for commercial and

[26] Municipal purchasing accounts for a limited percent of the West Chester Area's electricity demand. This demand can be met through a variety of strategies. For simplicity, the municipal purchasing policy wedge is currently represented assuming the entirety of municipal electricity demand, approximately 2% of total electricity demand by the community. Strategies that could be chosen to meet municipal electricity demand include procuring renewable energy from retail electricity providers, purchasing renewable energy credits, setting up an off-site PPA, and installing renewable energy on-site to supply municipal operations. Note that we assume that RECs are retired from all strategies for which RECs or SRECs would be created or purchased.

industrial customers, increasing the alternative energy portfolio standard, and a purchasing strategy that gets the municipal to 100% clean energy. Establishing and/or participating in group purchasing campaigns also can be seen in Figure 6 and has a as small yet visible contribution to increasing renewable electricity.

- Though not visible in Figure 6, a strategy that adds over 1,000 MWh of additional renewable electricity per year by 2050 includes allowing for community solar.

Figure 7 provides a snapshot view of the effect that each strategy has on increasing the level of renewable electricity, as illustrated Figure 6. Note that there are two bar plots separating high-impact strategies (greater than 10,000 MWh) and additional strategies (less than 10,000 MWh) into two categories. The additional strategies are also shown in Figure 7A as an aggregate value named "7B".



Columns marked with an asterisk (*) indicate strategies that are not generating renewable electricity. These bars instead represent the quantity of renewable electricity that would be demanded by these strategies as assumed. The share of renewable energy that contributes to their electricity demand is dependent on the share of renewable energy in the electricity mix. The cleaner the electricity mix, the cleaner these strategies will become.

Figure 7: Renewable Energy Generation by Strategy in 2050
7A. High Impact Strategies (Greater than 10,000 MWh impact)
7B. Additional Strategies (Less than 10,000 MWh Impact)

Given the importance of adding renewables to the supply mix in advance of pursuing electrification, this analysis largely focused on near-term opportunities to increase the amount of renewables within the electricity supply, in addition to a few select strategies that aim to electrify municipal buildings and the municipally owned vehicle fleet. Yet, in addition to what the townships can focus on in the next 5 to 10 years, and being mindful of the full renewable energy goal by 2050, Figure 8 below represents a scenario in which broader electrification occurs in the townships. Figure 8 shows electricity consumption by sector due to the electrification of the building and transportation sectors. The solid colors represent the forecasted electricity consumption by sector in the baseline while the cross-hatched wedges forecast the additional electricity consumption under the accelerated electrification scenarios. A key take-away from this electrification sensitivity scenario is to further emphasize the importance of near-term actions to enable and facilitate increasing renewables supplying the electricity mix.

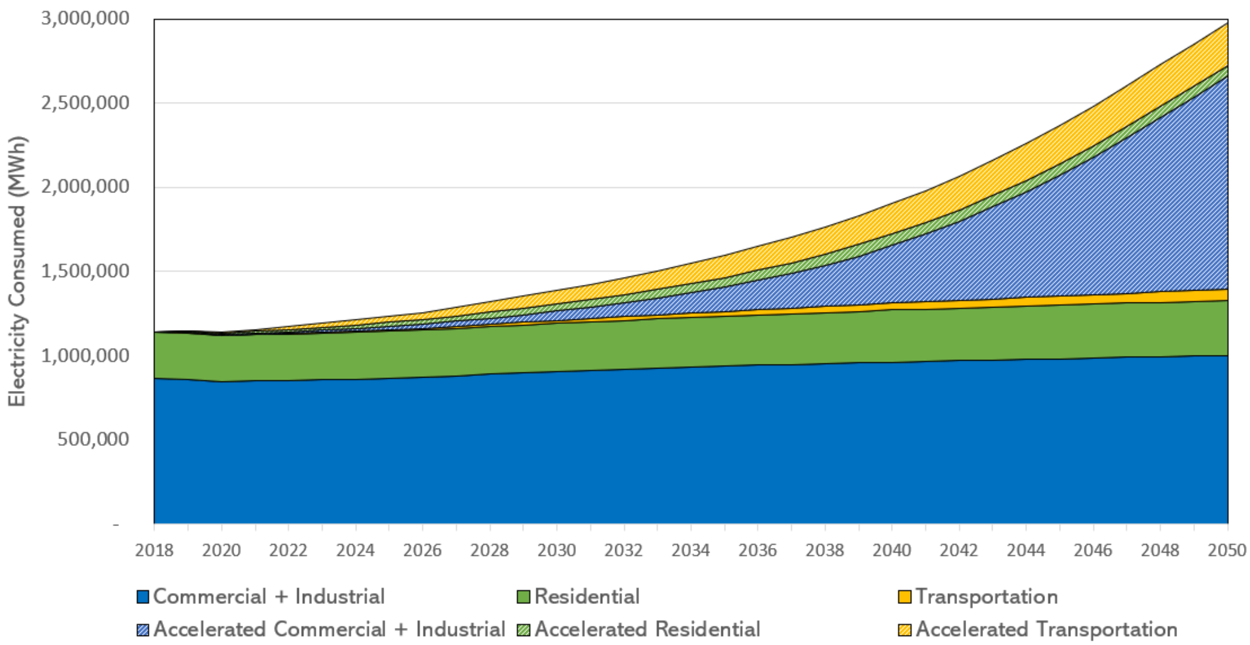


Figure 8: Effect on Electricity Consumption by Sector due to Electrification of Buildings and Transportation

Next Steps & Conclusion

WCA-Wide Collaboration

While maintaining individual local government decision-making, participating municipalities can increase both impact and resource efficiency through collaboration. Continued collaboration of local-level action may take several forms:

- **Continued connection.** The WCACOG Advisory Group that has supported preparation of this Renewable Energy study can continue to meet to share best practices and potential for collaboration by preserving regular meetings and sharing mutual learnings with COG members.
- **Aligning on strategy-specific inputs.** Fostering alignment on areas such as procurement requirements, building codes, and other areas can increase ease of doing business across the municipalities, which can support streamlined interaction with other parties such as solar installers, PECO, or others.
- **Direct partnership on procurement.** WCA municipalities may be able to benefit from economies of scale through joining energy or EV fleet procurements in the event that participating municipalities choose to implement these strategies. The WCACOG may choose to set up a standing joint procurement vehicle to enable ease of pursuing this type of partnership.

State-Level Collaboration

When extending beyond action under the direct control of WCA municipalities, collaboration at the WCACOG-level or even at the County-level would provide for a stronger and unified voice to advance supportive policy implementation at the state-level. Potential pathways and resources follow below:

- **Joint WCACOG or County perspectives.** At the state-level, representing a joint perspective can offer a greater opportunity for impact.
- **Connect with municipalities outside of WCA.** WCACOG municipalities can consider collaborating through forums such as Sierra Club forums, or the Urban Sustainability Directors Network (USDN).

Initial Next Steps

While strategy-specific implementation steps are provided earlier in the report, Table 1 provides a set of initial steps that can set the groundwork for strategy-level implementation.

Table 1: Strategy-Level Implementation Next Steps

Near-Term Step	Enabling	Community Engagement	Municipal Supply Mix	State-Level
WCACOG to consult with the Advisory Group on their recommendations based on the Cadmus Report.	✓	✓	✓	✓

Near-Term Step	Enabling	Community Engagement	Municipal Supply Mix	State-Level
Engage the community to review the findings of this study and offer avenues for engagement on strategies that each municipality prioritizes. Ensure engagements include previously consulted stakeholders.		✓		✓
Review the results of the Cadmus Team's solar siting exercise with decision-makers.			✓	
Access technical assistance by joining SolSmart.	✓	✓	✓	
Engage with other local governments and groups (e.g. Sierra Club or Solar United Neighbors) to uncover how WCACOG municipalities can collaborate on existing efforts at the state-level, and learn from others' local-level efforts.	✓	✓	✓	✓

Conclusion

This report acknowledges that the municipalities are some of many important actors in the WCA. As such, the report is oriented around supporting the WCA municipalities with an actionable set of strategies to illuminate, inspire, and facilitate the transition of the broader WCA community's energy system. The WCA municipalities participating in this study have taken a critical step by supporting the development of this report and review of potential pathways to achieve 100% renewable electricity by 2035 and 100% renewable energy by 2050. While the current energy trajectory (without additional action by the municipalities) is not expected to support the achievement of these goals, concerted action from the municipalities can support achieving these goals. This report outlines a suite of 18 first steps and no-regret actions that the WCA municipalities can undertake to make strong progress against these goals. The near-term opportunity for the West Chester Area lies primarily in increasing the renewable electricity supply. In the medium and long-term, electrifying the transportation and building sectors can enable a deeper shift to renewable energy. As such, most of the strategies in this report focus on increasing the renewable electricity supply, and a subset begin to lay the groundwork for electrification. Across strategies targeting both electricity supply and electrification, the strategies aim to enable local action, engage the community, demonstrate municipal leadership on renewable energy, and engage the municipalities at the state-level. In executing these strategies, the West Chester Area municipalities have the opportunity to build upon successes of other local governments in pursuing similar renewable energy goals; many of these examples are noted in this report. Lastly, as the West Chester Area continues to work towards its goals, it is recommended that this study should be periodically revised to account for technological, political, and economic shifts and local progress against renewable energy goals.

Appendix A. Summary of Findings from Stakeholder and Community Engagement Process

Overview of WCACOG's Energy Planning Process Stakeholder and Community Engagement

The Cadmus Team is supporting the West Chester Area Council of Governments (WCACOG) with a study to inform the development of the West Chester Area Regional Community Energy Transition Plan. Throughout the research and planning process, the Cadmus Team is engaging with an Advisory Group comprised of representatives from each WCACOG municipality that is participating in the study as well as the Delaware Valley Regional Planning Commission (DVRPC). The purpose of the Advisory Group is to provide critical input, feedback, and local knowledge to the Cadmus Team throughout the Renewable Energy Planning process.

In addition to the ongoing input from the Advisory Group, the Cadmus Team recently conducted a series of engagement efforts to ensure that forthcoming research and analysis is grounded in local goals and perspectives. These engagements included:

- **Interviews**: Conducted one-hour intake interviews with six Advisory Group members and one additional stakeholder. During these conversations, interviewees provided feedback on what excites them and concerns them about the transition to 100% renewable energy, as well as their vision for the West Chester Area's energy future and strategies they feel will help them reach their goals. A full list of interviewees is included in the table below:

Name	Title	Organization
Kerry Campbell	Environmental Program Manager	Pennsylvania Department of Environmental Protection
Liz Compitello	Manager, Local Initiatives	DVRPC
Mimi Gleason	Township Manager	West Whiteland Township
Dianne Herrin	Mayor	West Chester Borough
Scott Neumann	External Affairs Manager	PECO
Shaun Walsh	Supervisor	West Goshen Township
Will Williams	Sustainability Director	West Chester Borough
Jim Wylie	Executive Committee Chair	Sierra Club, Southeastern PA Chapter

- **Advisory Group workshop**: Facilitated an in-person 2.5-hour workshop with the full Advisory Group on July 11th to solicit further feedback from members and prepare for a Community Visioning Workshop held in West Whiteland Township later that day. The workshop provided a forum for the group to discuss their priorities for the Renewable Energy Plan, determine an appropriate bounding definition of clean energy for the purposes of this study, and consider renewable energy pathways the West Chester Area may pursue.
- **Community workshop**: Held a Community Visioning Workshop during which the Advisory Group members and the Cadmus Team facilitated conversations with community members to

begin defining a community energy vision for 2050, to identify different community priorities for municipal energy goals and priorities, and to discuss the community's specific needs, challenges, and desired outcome for the project. The workshop had approximately 60 attendees, who were divided into seven breakout groups for discussions.

- **Advisory Group conducted stakeholder interviews:** To further complement Cadmus Team's above-listed engagements, the Advisory Group members also conducted additional interviews with several stakeholders from local businesses, institutions, and municipalities.

Key Themes from the Stakeholder and Community Engagement Process

The key themes from the above engagement efforts are grouped into five categories that together comprise the remainder of the document:

1. Energy Planning Process
2. Results of the Energy Planning Process
3. Vision for the West Chester Area's Energy Future
4. Barriers and Solutions to Vision for the West Chester Area's Energy Future
5. Pathways and Policies to Enable the West Chester Area's Energy Future

Energy Planning Process

This section covers the key priorities and opportunities shared by stakeholders and community members related to the study and associated energy planning process. The following qualities of an ideal energy planning process emerged from the discussions:

- **Collaborative and fostering a sense of community.** Stakeholders and community members envisioned municipalities within the COG working together to achieve shared goals and fostering a greater sense of community in the process.
- **Transparent**. A clear priority for the process of renewable energy planning and execution was openness and transparency. Community members would like to be informed on the process and involved where possible.
- **Leading.** The planning process offers the chance for the WCACOG jurisdictions to become local and regional leaders on climate action. Stakeholders and community members expressed hope that this process can serve as a model for other communities working towards similar goals and as an opportunity to be creative to address barriers. Due to their role on the energy planning process, Advisory Group members expressed excitement to be a part of the process by providing local context and, in some instances, technical expertise. Most Advisory Group members view this as a learning process for themselves and expect to bring this knowledge back to their communities.
- **Addressing climate change**. Constituents have expressed growing concern over climate change due to increasingly unusual weather and greater awareness of the issue. This greater awareness is partially due to the efforts of an active Ready for 100 Team that is dedicated to educating the community on the importance of renewable energy. As such, it will be critical to ensure that the energy transition serves as an opportunity to address climate change and communicate on that topic with community members.

Characteristics of the Energy Plan

This section highlights key priorities voiced by stakeholders and community members related to the renewable energy transition plan itself (e.g. what they envision for the overall structure of the plan). Key priorities include:

- **Action-oriented**. Advisory Group members articulated that they would like a Renewable Energy transition plan that includes both a long-term roadmap, and concrete, actionable, feasible, short-term steps they can take. They would like the plan to be collaborative and sufficiently granular by party so that they can begin advancing their transition immediately. Advisory Group members also feel like an actionable plan with clear steps will set them up best for success. One component of an actionable plan is clearly denoting what actions lie within as well as beyond local control or sphere of influence. Some discussions provided specific examples of what actions may entail, such as updating building codes or drafting new legislation with specific renewable energy goals.
- **Includes both near-term and long-term strategies**. In line with their vision of a plan that includes a long-term roadmap and short-term steps, Advisory Group members discussed strategies, policies, and programs that they expect will come out of the energy transition planning process in both the near-term and the long-term. In the near-term, they envision pursuing strategies within the electricity sector, such as public education, energy purchasing options, and a solar PPA that is similar to the City of Philadelphia's PPA. In the long-term, Advisory Group members envision pursuing strategies focused on decarbonizing other sectors, including buildings and transportation. Relatedly, the long-term strategies would necessarily involve building institutional infrastructure for meeting local renewable energy goals.
- **Emphasizes consensus and community engagement**. Advisory Group members stated that they hoped the plan would help develop consensus and drive community engagement with residents and businesses. They hope that the regional collaboration would drive continued meetings on implementation. Similarly, both community members and Advisory Group members emphasized that to build consensus, it will be important to frame this work as generating more energy options, rather than a mandate for individual-level actions.

Vision for the West Chester Area's Energy Future

The below section outlines themes that arose regarding what an ideal energy future would look like for the West Chester Area.

- **Utilization of renewable sources of energy generation.** Stakeholders and community members described an energy future in which conventional sources of electricity have been retired, and clean renewable energies dominate the industry. Wind and solar energy were frequently cited as the leading energy sources in West Chester's energy future.
- **Large-scale electrification.** Discussions highlighted the importance of transitioning to a greater reliance on electricity as a means to improve the utilization of renewable energy sources. Community members also described complimentary key advancements, such as improved

energy efficiency and grid reliability, that will support such a transition. Transportation and building electrification were noted as likely challenges given the region's context.

- **Improved quality of life and public health.** Improved public health and quality of life came up in several breakout groups and interview discussions. Key concepts such as clean air, clean water, less pollution (including noise pollution), and easily accessible and efficient public transit systems were often mentioned, in addition to a sense of community pride and accomplishment.
- **Affordable and equitably distributed resources.** Financially viable energy sources that enabled equitable access to renewable energy and technologies was another key theme. Equity was defined to encompass both equitable outreach in target communities and equitable access to renewable energy resources. Community members envisioned a future in which clean energy resources are affordable and cost-effective, perhaps supported by local incentives.
- **Enhanced resilience.** Advisory Group members highlighted the importance of a resilient energy supply system that will remain constant and reliable even in the face of natural disasters or other potential threats.

Barriers and Solutions to the Vision for the West Chester Area Energy Future

Throughout the community and stakeholder engagement process, the Cadmus Team sought input on what barriers may exist to achieving the community's envisioned energy future. Additionally, the Cadmus Team solicited input on the types of solutions that could address key barriers. Table 1 outlines the key barriers and solutions discussed.

Table 1: Key Barriers and Potential Solutions

Category	Barriers	Solutions/Strategies
Technological Barriers	Technological barriers of renewable energy were described as a principal roadblock to a successful energy transition. These barriers include intermittency and siting issues with wind and solar, storage capacity, the amount of renewable energy that would be necessary to replace the nuclear baseload, and how to manage excess energy, land requirements, and aging infrastructure.	Solutions to many of these key barriers, like intermittency and storage, were not always identified. To address the land requirements barrier, participants proposed more abundant and accessible federal and state grants for land purchase or conservation easements for solar arrays. One suggestion was establishing community solar when rooftop solar is unattainable, due to climatic/geographic variables or otherwise.
Dual Barriers of Lack of Awareness and Technical Complexity	The general lack of awareness for existing renewable energy programs, benefits, and alternatives was noted as a key barrier. Additionally, there was a concern that the challenge is complex and could overwhelm people who are new to the issue, thereby derailing action. The information gap spans from property owners, who may not know where to start	Many participants proposed community outreach efforts to promote greater awareness and incentivize action. These educational events would bring greater understanding of renewable energy, its costs and benefits, what incentives or programs are available, etc. Suggestions for increasing awareness ranged from public campaigns led by local representatives, establishing a sustainability coordinator or committee, greater social media outreach and digital marketing (e.g. factsheets or

	or have fundamental questions about cost, to elected officials with insufficient knowledge of the industry. Some participants also highlighted the lack of education and even misinformation around climate change and renewable energy technologies as a barrier.	videos with easily reproducible steps). Additionally, some participants mentioned energy and environmental education in schools. To bridge the knowledge gap on climate change, participants suggested clearly outlining the consequences of climate change and relating the impact in monetary values.
Political Barriers	Political barriers, particularly at the state and national government levels, were cited as a chief barrier to largescale adoption of renewable energy. For example, lack of support from the federal government and pushback from climate change opposers makes it challenging to draft effective policies. Political barriers also exist at the local level. Advisory Group members pointed out that some local officials are wary of clean energy investments and that additional political buy-in from these officials is necessary. Furthermore, limited ability to drive change at the local government level, and the challenge of working across jurisdictions were also cited as political barriers.	Holding open discussions with elected officials was mentioned as a strategy to generate greater awareness and attention that could lay the groundwork for political action. Greater outreach and education for the general public was consistently posed as means of reducing resistance for climate change legislature. Additionally, queued State Bill 630,[27] currently pending in the legislature, was mentioned as a favorable example of forward thinking and proactive policies. Fostering a sense of generational responsibility frequently came up as a priority and value. Community members noted a sense of obligation to preserve the planet for future generations. Building on this sentiment may help address barriers of political will among the general population. Additional solutions include hiring a sustainability coordinator and/or establishing a legal body that is responsible for executing the solutions identified in the plan.
Regulatory Barriers	Some stakeholders flagged that due to Pennsylvania's deregulated electricity market context, PECO does not own electricity generation, and its energy procurement process is highly regulated. These factors pose some limitations to the utility's ability to support renewable energy goals (note: these limitations do not apply to all pathways to support renewable energy goals, such as opportunities to	Stakeholders cited actions the utility has taken to support renewables. These actions include: starting both a Distributed Energy Group that facilitates the installation of renewables and a Utility of the Future team that is studying the implications of distributed energy on the utility business model, as well as the future needs of the grid, which may be impacted by the integration of distributed energy resources, aging infrastructure, or extreme climate events.

[27] This Bill paves the way for the transition to renewable energy by imposing duties on the Department of Environmental Protection and other agencies regarding energy consumption and renewable energy generation. Bill 630 also establishes a Clean Energy Transition Task Force, Just Transition Advisory Committee, Clean Energy Workforce Development Fund, among others, and provides for interim limits on energy produced from nonrenewable resources.

	improve interconnection of distributed generation).	Stakeholders also raised that PECO's ability to support renewables is largely influenced by the regulatory environment in which it is operating. Changes to the regulatory environment may enable, or in some cases require, PECO to take more action. One example cited by stakeholders is Act 129.[28] This Act currently focuses on energy efficiency, but some stakeholders expect it may be expanded to include renewable energy targets as well. This may be an opportunity for West Chester Area jurisdictions to collaborate with the utility to advance renewables. Stakeholders flag, however, that changes to the regulatory environment are often under the authority of decisionmakers, such as the Public Utility Commission. Stakeholders from a variety of backgrounds also indicated an interest in open communication and collaboration between the utility, local governments, and community members.
Cost Barrier	Cost arose as a barrier that prevents households, particularly low-to-moderate households, from participating in renewable energy programs. In addition to the high upfront costs, economic uncertainty from financial incentive programs and technologies were also presented as deterring participation.	Technological improvements and innovations were often cited as a means of improving performance and therefore minimizing the costs. Furthermore, community members proposed more funding for financial incentives and subsidies, in addition to federal grants for land purchase, to increase access to renewable energy for a broad spectrum of the population.

Pathways and Policies to Enable the Vision for the West Chester Area's Energy Future

While the focus of community and stakeholder engagement efforts was not to generate specific policy options for increasing renewable energy, one aspect of the Advisory Group workshop was a focused policy discussion. Table 2 summarizes core areas of interest from the Advisory Group, segmented into three categories (represented by three columns). These areas will be researched in depth during the policy and strategy analysis that the Cadmus Team will undertake during the coming months.

[28] Act 129, passed by the General Assembly and implemented by the PUC, requires electric distribution companies, such as PECO, to develop energy efficiency and conservation plans to achieve electricity consumption and peak demand reduction targets. The Act is implemented in phases, and is currently in Phase III until 2021. Stakeholders interviewed shared the Phase IV negotiations will begin soon.

Table 2: Advisory Group Areas of Interest

Local Government	Collaboration Beyond Local Government	Alternative Purchasing Options
• Building permit form changes • Local incentives • Zoning ordinances (uniform) • Incentives • Multi-municipal aggregation • Aggregation with universities, shopping complexes • SolSmart participation • Simplify permitting and inspection processes for renewable energy installations	• Work with developers • Work with the state legislature • Bulk purchasing • Demonstration project with PECO • Educational Institutions	• Virtual Power Purchase Agreement (PPA) • Renewable Energy Certificates (RECs)

Finally, the Advisory Group workshop also included a brief discussion on the appropriate definition of renewable energy in the context of this study. While the Advisory Group recognized that it is a nuanced question, it recommended focusing less on nuclear, biomass, and RECs for the purposes of this study. In contrast, some other stakeholders highlighted the role of nuclear in the renewable energy transition and expect it will be necessary to fill some of the gaps caused by the intermittency of renewables. One nuance raised was that the low cost of natural gas may forestall use of nuclear and renewables.

Next Steps

The Cadmus Team will utilize the results from the stakeholder and community engagement exercises to inform its policy and strategy research and evaluation process the WCACOG.

In the immediate term, a survey will be distributed to community members as a follow-up to the community workshop. In the Fall, the Cadmus Team and the Advisory Group will host a second open workshop to share the results of the research and analysis.

Appendix B. Full List of Potential Renewable Energy Strategies

The project Advisory Group prioritized 18 strategy options from an initial list of 42 strategy options, listed below:

ID	Strategy	Description
Electricity Sector Strategies		
1	**Reduce Permitting, Zoning, and Inspection Barriers to Renewable Energy**	Streamline the permitting, zoning and inspection processes so that processing time and expenses are reduced. This may include streamlining permitting processes for specific technologies that meet certain standards, and eliminating redundancies from inspection protocols.
2	**Adopt or Promote Solar Ready Guidelines**	Encourage or require new buildings to be built in a way that accommodates future solar installations.
3	**Local Requirements for Local Renewable Energy Production**	Require renewable energy development in certain cases, such as new construction. This may be implemented through zoning code review, which SolSmart technical assistance could support.
4	**Lease Public Land for Renewable Energy Development**	Offer property for lease to utilities or developers to host renewable energy projects.
5	**Purchase Renewable Energy On-Site to Supply City Operations**	Install renewable energy projects on municipal facilities and land.
6	**Establish Renewable Energy Educational Campaigns**	Employ education campaigns to create community support for other RE strategies and to encourage voluntary action at an individual or private business level.
7	**Engage the Community in Setting Energy Goals**	Convene, facilitate, and/or support on-going public discussions with the community around energy goals
8	**Establish and/or Participate in Group Purchasing Campaigns**	Host or support group purchasing programs for renewable electricity (e.g. Solarize campaigns) to reduce costs and support market development.
9	**Local Renewable Energy Non-Financial Incentive Program(s)**	Participating municipalities establish programs to incentivize renewable energy for residents and businesses. These programs may include local competitions where the primary incentive would be public recognition of achievement.
10	**Local Renewable Energy Financial Incentive Program(s)**	Establish programs to incentivize renewable energy for residents and businesses. Such programs could include tax rebates for renewable energy installations, tax credits, exemptions from property taxes, and zero interest and forgivable loans.

11	**Procure Renewable Energy from Retail Electricity Providers**	Purchase electricity from a competitive supplier to supply municipal operations with renewable energy.
12	**Partner with a Third Party to Procure Renewable Energy**	Partner with an independent power producer to directly procure renewable energy for municipal operations through a power purchase agreement.
13	**Virtual Power Purchase Agreements (VPPAs) (aka Financial PPAs)**	"A financial PPA (Financial PPA) is a financial arrangement between a renewable electricity generator (the seller) and a customer, that enables both parties to hedge against electricity market price volatility. Unlike with a physical power purchase agreement (PPPA), there is no physical delivery of power from the seller to the customer. Rather, it is a hedge arrangement that offers buyers cost predictability for their electricity use and promotes growth in the renewable energy sector by offering project developers long-term contracts with predictable revenues — a key element to attracting project financing and investment. Financial PPAs are also sometimes known as virtual or synthetic PPAs, a contract for differences, or a fixed-for-floating swap. Financial PPAs are an innovative and useful procurement option for organizations, particularly those in traditionally regulated electricity markets that generally do not permit PPPAs" - EPA definition
14	**Renewable Energy Credit (REC)-based Purchasing**	Purchase RECs as a means to realize local energy targets. Participating municipalities could also provide information to residents and businesses to consider them to purchase RECs.
15	**Allow for Community Solar**	The State enacts legislation that allows for community solar in Pennsylvania.
16	**Allow for Community Choice Aggregation (CCA)**	The State enacts legislation that allows for community choice aggregation in Pennsylvania.
17	**Increase Alternative Energy Portfolio Standards Act**	The State enacts legislation increasing utility commitments for renewable energy purchasing.
18	**Establish formal COG-Utility Partnership**	Form a partnership with PECO to jointly set goals and develop programs for implementation locally.
19	**Work with PECO to Develop a Demonstration Project**	Collaborate with PECO to develop a demonstration project. A demonstration project could alleviate distribution-level congestion, reduce peak demand, and install storage.
20	**Streamline Interconnection Processes**	Interconnection is the process by which a new distributed energy generation resource such as a solar, wind or hydropower system, is connected to the utility's grid. Once a renewable energy project has been built, it can be interconnected in order to provide power to the grid. This interconnection enables off-takers from the

		project to receive credit for their project's energy contributions to the grid through a process called net metering (described in the Electricity Landscape section of this report). Interconnection requires approval from the utility and can involve a lengthy process, depending on whether any grid improvements are needed to support the additional load or the number of additional applications that are in the queue. Participating municipalities could collaborate with PECO to develop more transparent, standardized, and in some cases automated utility interconnection procedures.
Transportation Sector Strategies		
21	**Reduce Permitting Costs and Timeline**	Participating municipalities can streamline permitting and inspection processes for the installation of electric vehicle supply equipment (EVSE) so processing time and expenses are reduced. Some best practices for streamlining EVSE permitting include 1) Making permits available online or over-the-counter, 2) Issuing required permits in under 48 hours, 3) Offering reduced or free permitting fees, 4) Creating guidance documents such as a checklist to guide applicants through the process, 5) Limiting the number of inspections required, 6) Limiting requirements for supporting materials and site plans.
22	**Pass EV-Ready Ordinances**	Participating municipalities can require (through their building code) new buildings and/or major renovations to require certain levels of EV readiness, such as requirements for pre-wiring, full circuit installations, sufficient electric panel capacity and/or actual charger installation in a certain percentage of parking spaces.
23	**EV-Ready Zoning**	Participating municipalities can use their zoning code to incentivize or require additional EV readiness actions. The city could enable EV parking (or e-bike and e-scooter parking/charging) to count towards minimum parking requirements, or count for multiple parking spaces to combine objectives for lower parking and EV use. Additionally, the city could utilize the zoning code to incentivize developers to install more chargers (e.g. through density bonuses) or require charger installations (in addition to just pre-wiring and other provisions required by the building code).
24	**Procure Electric Vehicles for Municipal Fleet**	Participating municipalities can integrate EVs as part of their municipal fleets. Multiple municipalities could consider making an aggregated purchase or lease of EVs for their public fleet. These purchases may also capture the full value of incentives at the state and federal level via leasing arrangements with private entities. This may also include efforts to electrify school bus fleets, and/or

		support electrification of transit bus fleets if not owned/controlled by the municipality.
25	**Install Public Charging Stations**	Participating municipalities could build out EV charging infrastructure in publicly owned buildings, parking lots, or in the right-of-way. Increased availability could spark public interest, reduce range anxiety, and present an opportunity to educate municipal employees and public stakeholders about the benefits of EVs.
26	**Establish Electric Vehicle Educational Campaigns**	Participating municipalities establish a variety of educational campaigns to increase consumer awareness and interest in EVs. This may entail activities, such as "ride and drives" where EV owners, dealers, or manufacturers showcase vehicles and allow interested participants to drive an EV.
27	**Establish and/or Support EV Group Purchasing Programs**	Participating municipalities could organize or support group purchasing programs for EVs to reduce costs and support market development.
28	**Workplace Charging Challenge**	Participating municipalities could develop a workplace charging challenge, or an awareness and information campaign focused on expanding EV charging access in commercial buildings, targeting employers and building managers of commercial properties. The program would recognize employers who commit to workplace charging and could highlight employers who have done the most to increase EV charging. The program could also provide technical assistance to workplaces.
29	**Establish Local EV Financial Incentive Program(s)**	Participating municipalities can establish programs, such as rebates, to incentivize EVs or EVSE for residents, multi-family residential building owners, and businesses/institutions.
30	**Integrate Utility into Interconnection Procedures**	Participating municipalities can engage PECO throughout permitting and related interconnection process to identify premium locations that require minimal electrical infrastructure updates.
31	**Establish and/or Support Electric Carsharing Program**	Through public-private partnerships with car-sharing business entities and local community stakeholder groups, participating municipalities can pilot an electric car-sharing program that allows individuals with a license to access a network of shared EVs and chargers at a low rate.
32	**Electrifying Taxis and Ridesharing Companies**	In partnership with transportation commissions, COG/participating municipalities could establish pilot programs for the integration of, or provide financial incentive for, the electrification of taxis and/or ridesharing vehicles.

Building Sector Strategies		
33	**Complete a Building & Market Segmentation Analysis**	Participating municipalities create an inventory of city-wide buildings drawing from a variety of sources, including utility, assessor, permitting, census, and other datasets to conduct a segmentation analysis of building inventory to identify key barriers and opportunities for heat pump deployment.
34	**Develop Local Building Electrification Roadmap**	Participating municipalities create a plan to guide building electrification efforts, including policy and program recommendations, as well as near and/or long-term targets for building electrification, along with metrics for success.
35	**Lead by Example in Municipal Facilities**	Participating municipalities establish "lead by example" programs to design and implement electrification projects and retrofit strategies in public facilities.
36	**Support Building Electrification Supply Chain Development**	Participating municipalities design and implement programs and policies that will support the development of a building electrification supply chain that can support market development. Relevant programs could include, contractor training and recruitment, the standardization of contractor qualification requirements, or contractor pipeline development programs.
37	**Renewable Heating and Cooling Marketing and Educational Campaigns**	COG/participating municipalities establish and/or strengthen marketing and educational campaigns to raise awareness and understanding of building electrification technologies.
38	**Renewable Heating and Cooling Group Purchasing Campaigns**	COG/participating municipalities host or support a community group purchasing campaign that aims to raise awareness, educate residents, and connect prospective customers with qualified contractors that may be able to offer heat pump installations at a discounted rate.
39	**Renewable Heating and Cooling Financial Incentives**	Participating municipalities provide incentives to reduce the upfront costs of building electrification technologies.
40	**Implement District (Large- or Micro-Scale) Geothermal**	Participating municipalities develop distribution networks to supply buildings with heat from geothermal energy. District geothermal could be implemented on a large- or micro-scale. A preliminary step may involve hiring a geothermal consultant to perform district feasibility assessments.
41	**Establish a Formal City-Utility Partnership**	Participating municipalities establish a formal partnership with PECO to create a framework for shared municipality-utility building electrification goals.
42	**Collaborate to Advance State**	Collaborate with other actors to advance exploration of code-

	Building Code	based interventions to encourage electrification of buildings.

Appendix C. Modeling Assumptions

The tables on the following pages summarize the energy modeling methodology and the assumptions related to both the energy impact modeling and financial calculations of the modeled strategies.

Strategy 2: Install Renewable Energy On-Site to Supply Municipal Operations Install renewable energy projects on municipal facilities and land. The municipality could directly own the installation or consider a third-party ownership model via a solar lease or power purchase agreement (PPA).	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
This strategy first establishes estimates for rooftop solar installation using average solar potential of municipal buildings. Then we assume that each municipality adds solar to two buildings each year for five years.	• Assume we install rooftop solar. • Assume average solar potential of municipal buildings of 100 MWh (sourced from Cadmus siting task excluding the Public Works Annex & Court which is the largest building at 400 MWh). This is about equal to an 81.5 kW system per building. • Assume each roof has a solar capacity factor equal to PA solar availability of 14%. • Assume each municipality adds solar to 10 buildings (60 installations total) • Assume solar is added to municipal buildings over a 5-year period. This results in adding solar to two buildings in each township every year. **Direct Ownership Financial Assumptions** • Assume the cost of installing commercial scale municipal solar systems is $2.1/watt (NREL). • Calculate levelized cost of energy assuming a 30-year solar system lifespan, a 3% discount rate, and using the installation cost as the only cost. • Assume the total municipal electricity rate is $0.079/kWh (Rate is sourced from supply and distribution rate data provided by the townships: supply rate from Constellation Energy of $0.057/kWh and a distribution rate from PECO of ~$0.022/kWh). • While SRECs could lower the cost of owning and installing solar systems at a rate of ~$40/MWh, this potential source of revenue is not included because selling SRECS would preclude the municipalities from claiming the renewable generation. • Assume that net metering (and therefore savings) applies only to the energy supply portion of the electricity bill ($0.057/kWh) per the commercial tariff. Assume there is no Federal Investment Tax Credit (FITC) as, per law, it does not apply to municipalities.

	Lease Solar Panels from Developer Financial Assumptions • Assume the total municipal electricity rate is $0.079/kWh (Rate is sourced from supply and distribution rate data provided by the townships: supply rate from Constellation Energy of $0.057/kWh and a distribution rate from PECO of ~$0.022/kWh). • Note that we only consider the energy supply rate of $0.057/kWh when comparing to the fixed price PPA, given that the commercial tariff in PA only allows commercial solar projects to be credited for supply and not distribution charges. • Assume that the townships set up a fixed price PPA that comes in 35% higher than the City of Philadelphia's PPA established in late 2018. • Given that the Philadelphia PPA is $0.0445/kWh, assume that the townships pay $0.06/kWh over the lifetime of the project for all municipal facility electricity use. • Thus, for leasing a solar PPA, the townships will pay an extra $0.003/kWh.

Strategy 5: Establish and/or Participate in Group Purchasing Campaigns Host or support group purchasing programs for renewable electricity (e.g. Solarize campaigns) to reduce costs and support market development.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is based on the annual solar installation rate for the townships in 2018. From this installation rate we assumed that a Solarize program would be designed to increase the solar installation rate by 50%.	• Find the rate of solar installations in Chester County in 2018 using PJM Generation Attribute Tracking Systems (GATS) data • Scale this rate of new installations to the West Chester Area by population. • Estimate that a solar system installation is 5 kW on average. • Assume that the program is designed to increase installation over the baseline growth rate by 50%. (Note that increasing the solar installation rate by 50% results in an installation of ~116 residential systems across the townships per year.) • Assume that this program occurs every year through 2050. • Assume that the program installation rate increases by 0.5% each year due to improved solar technology, reduced costs, streamlined permitting, and program popularity. • Assume the townships partner with a non-profit to run the solarize campaign and that municipal costs will be due to time spent selecting a non-profit, coordinate action with them, and outreach in community for solarize program. Otherwise the cost to the townships to run the entire program themselves may be about $15,000 per campaign.

Strategy 6: Procure Renewable Energy from Retail Electricity Providers Purchase electricity from a competitive supplier to supply municipal operations with renewable energy.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is determined by setting a target of municipal electricity to be purchased through retail providers. This target is then met through retail electricity provider procurement.	• Assume that the township municipalities purchase renewable energy from retail electricity providers to meet 100% of their municipal operations. • Assume these purchases start in 2019 and go through 2050. • Assume that the townships choose an electric supplier which offers a 100% renewable electricity supply option. Assume that the cost of this supply is a pass-on of the PA Tier 1 REC cost of $6/MWh. • Thus, the rate increase to purchase 100% renewable supply is $0.006/kWh.

Strategy 7A: Power Purchase Agreement - Partner with a Third Party to Procure Renewable Energy Participating municipality(s) partner with an independent power producer (IPP) to procure renewable electricity for municipal operations through a power purchase agreement. There are multiple strategies for engaging in a power purchase agreement, including a physical PPA versus a virtual PPA. For the purpose of this analysis, the Project Team focused on physical PPAs.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is determined by setting a target of municipal electricity to be purchased through a PPA. This target quantity is procured and incorporated into the renewable energy mix supplying the townships.	• Municipal facility electricity demand in 2018 is ~23 GWh (township data scaled by population from West Chester Borough municipal facility electricity load in 2018). • Assume WCA wishes to purchase 100% of existing non-renewable electricity share through PPAs by 2035. • Assume municipal non-renewable electricity demand is ~22 GWh. • Assume first PPA purchase occurs in 2025 and covers all municipal facility electricity. • Assume that PPA prices are stable through 2050. • Assume that the townships set up a fixed price PPA similar to the City of Philadelphia's PPA established in late 2018. • Assume the townships pay the same rate as the Philadelphia PPA of $0.0445/kWh over the lifetime of the project for all municipal facility electricity use. • Assume the total municipal electricity rate is $0.079/kWh (Rate is sourced from supply and distribution rate data provided by the townships: supply rate from Constellation Energy of $0.057/kWh and a distribution rate from PECO of ~$0.022/kWh). • Assume that only the supply portion of the rate ($0.057/kWh)

	is credited from an offsite PPA.

Strategy 7B: Commercial and Industrial Purchasing* Assume that the actions and encouragement of the townships inspire C&I customers to set up clean purchasing strategies for meeting a share of C&I electricity demand. **Note that energy modeling was conducted for C&I sector purchasing at the request of the Advisory Group; corresponding policy feasibility or financial analysis were not included given that the C&I sector may pursue renewable purchasing through a variety of avenues as outlined in other strategy options for the participating municipalities.*	
Energy Modeling Methodology	**Modeling Assumptions**
The effect of this strategy is determined by setting targets for commercial and industrial electricity to become clean through some renewable energy purchasing mechanism (RECs, Offsite PPA, etc).	• In 2015, DVRPC data shows C&I users representing ~76% of total electricity demand for the townships. • Assume that C&I customers start purchasing clean electricity in 2021 with a linear rate of increase until 25% of C&I customers purchase 100% clean electricity by 2025. • Assume that by 2050, 50% of C&I customers purchase 100% clean electricity. • Note that 10% of C&I electricity load is equal to ~86,200 MWh, which would require a PPA about the size of the Philadelphia Adams PPA (a 70 MW solar plant), which produces about 86,000 MWh of electricity per year.

Strategy 8: Renewable Energy Credit (REC)-based Purchasing Purchase RECs as a means to realize local energy targets. Participating municipalities could also provide information to residents and businesses to consider them to purchase RECs.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is determined by setting a target of municipal electricity to be purchased through internal RECs. Apply the RECs purchased to the electricity mix as renewable energy.	• Assume WCA purchases 100% of existing non-renewable electricity share through internal RECs by 2035. • Assume that REC purchases increase linearly by 10% year over year to reach 100% by 2035. • Assume that each REC purchase contract lasts 1 year, and that prices are stable through 2050. • Assume the price of a PA Tier 1 REC of $6/MWh (2019 Evolution Markets Data) • Assume the price of a TX Wind REC of $0.75/MWh (2019 Evolution Markets Data)

Strategy 9: Allow for Community Solar The State enacts legislation that allows for community solar in Pennsylvania.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is	• Assume that community solar is enacted in 2021 and the first

determined by assuming a consistent level of involvement from residents in the townships. The number of residents involved in a program each year is scaled per residential electricity use to determine the size of the community solar installation each year.	program begins in 2022. • Assume that one community solar program occurs every year from 2022 to 2050. • Assume that in the first year 100 residents sign up and that, by 2050, the number of residents participating each year increases to 200 per year. • Assume the increase in participation occurs linearly over the 28 years from 2022 to 2050. • Assume that the average resident in the townships has an annual electricity consumption of ~2.6 MWh (based on DVRPC data) and that they enroll in the community solar program to cover half of their electricity use. • Determine the community solar to add per program each year based on the number of people and their energy consumption. • Cost depends on how community solar program is implemented. One option is for community members to subscribe to the project and receive a rebate on their electricity rate through net-metering. This results in about a 10% decrease on average in their electricity rate.

Strategy 10: Allow for Community Choice Aggregation (CCA) The State enacts legislation that allows for community choice aggregation in Pennsylvania.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is determined by using opt-in and opt-out CCA program timeline and residential adoption information based on feedback from the WCA Advisory Group.	• Assume an opt-in program is enacted in the townships in 2023 and 200 residents sign on each year from 2023 to 2026. • Assume the opt-in program provides a 30% renewable premium above the baseline mix. • Assume an opt-out program is enacted in the townships in 2026. • Assume that the townships renegotiate their CCA every year in an aggressive manner to reach a 100% CCA mix by 2035. This results in the townships increasing their CCA mix by 7% each year until it is 100% renewable in 2035. • Assume that 50% of residents continue participation in the CCA, 50% of residents opt-out. • Assume that the opt-out mix is equivalent to the baseline renewables mix in each year. • Assume the electric supplier to provide 100% renewable electricity passes on the renewables premium at the same rate as the price for PA Tier 1 REC in 2019 of $6/MWh (Evolution Markets Data). • Assume the average monthly consumption for a residential home in PA is 568 kWh (2018 DVRPC data on residential electricity use and residential household building count). • Assume the municipal facility electricity demand in 2018 is ~23

	GWh (township data scaled by population from West Chester Borough municipal facility electricity load in 2018).

Strategy 11: Increase Alternative Energy Portfolio Standard The State enacts legislation increasing utility commitments for renewable energy purchasing.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
This strategy makes assumptions about potential legislative changes to the AEPS and applies it to the Pennsylvania electricity mix. Doing so illustrates the effect that more aggressive state energy policy can have on local electricity supply.	• Assume that the PA state legislature increases the AEPS targets as follows: ○ 20% Tier 1 by 2030 - enacted by 2022 ○ 50% renewable by 2040 - enacted by 2028 ○ 80% Tier 1 by 2050 - enacted by 2035 • Given the above, we model the energy impacts of the AEPS to increase renewables to 40% by 2040 and 80% by 2050. • Note that NREL/LBNL estimates that electricity price increase due to a high renewables RPS for the Middle Atlantic region is anticipated to range from $0.004/kWh to $0.036/kWh. • Assume the median of the lower and upper bounds of electricity price increase resulting in $0.020/kWh. This represents an increase in electricity prices for all electricity rates. • Assume the average monthly consumption for a residential home in PA is 568 kWh (2018 DVRPC data on residential electricity use and residential household building count).

Strategy 12: Streamline Interconnection Processes Collaborate with PECO to simplify utility interconnection procedures.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
The effect of this strategy is determined by finding the cost savings through streamlining interconnection processes. These savings are converted to an increase in solar demand which is applied as an increase in the renewables mix.	• Assume that streamlining interconnection processes decreases the interconnection cost of new solar by 50%. • Assume the solar energy price elasticity of demand is –0.65. (2017 Yale study on solar PV) • Current costs for residential solar PV systems for interconnection are $0.05/W (NREL). Commercial costs differ for this strategy and are not modeled. • We assume a 50% decrease in this cost resulting in a cost decrease in solar PV installation of $0.025/W. • This cost savings is applied on top of any solar installation.

Strategy 14: Procure Electric Vehicles for Municipal Fleet Participating municipalities can integrate EVs as part of their municipal fleets. Multiple municipalities could consider making an aggregated purchase or lease of EVs for their public fleet. These purchases may also capture the full value of incentives at the state and federal level via leasing arrangements with private entities. This may also include efforts to electrify school bus fleets, and/or support electrification of transit bus fleets if not owned/controlled by the municipality.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
This effect of this strategy is based on how many municipal vehicles the townships wish to electrify. These inputs are used to determine the number of vehicles to procure each year. The effect on the energy mix is directly related to the share of vehicles being electrified with a corresponding decrease in municipal vehicle gas use.	• Assume EV procurement applies to only the municipal fleet. • Assume a desire to electrify 100% of the municipal fleet by 2050. • Note that electrifying the entire fleet results in the need for ~10 municipal vehicles to be electrified per year each year until 2050. To reflect improving technology and decreasing costs, we model this by assuming that 5 vehicles are electrified per year for the first 10 years, then 10 vehicles per year for the following 10 years, and 15 vehicles per year for the years leading up to 2050. • Note that we consider an EV to be plug-in or full electric vehicles but do not consider hybrid vehicles to be EVs. Given this, the townships currently have 4 EV vehicles. • The 2019 Nissan Leaf was chosen as the electric vehicle to model in consultation with the Advisory Group. The AG also suggested using Nissan Kicks for the gas counterpart, but there is no total cost of ownership (TCO) data available to use for financial estimations (as it is a relatively new car). The reasoning for changing the vehicles we compare was driven by 1) price comparability and 2) trim/features comparability. While there weren't other vehicles with comparable trim in the Nissan line to the Nissan Leaf, we chose the most comparable car with respect to price for the analysis, the 2019 Nissan Sentra. Note that we also considered the Nissan Versa, however based on price comparability with the Nissan Leaf, chose the Sentra. • Project the costs of these vehicles out to 2050 (using existing data to establish the compound annual growth rates for cost). • Calculate the difference in costs based on our projections. • For the Total Cost to Own (TCO) analysis, we looked at factors that would differ between gasoline and electric vehicles. These factors include upfront price, maintenance and repairs, fuel, and depreciation. • Upfront price forecasts projected using a compound annual growth rate determined by using the last six years of data.

	• All remaining factors calculated using Edmunds 5-year TCO studies as foundations for the 2050 projections. Edmunds conducted the study for both the 2019 Nissan Leaf and the 2019 Nissan Sentra.
Strategy 17: Lead by Example in Municipal Facilities Participating municipalities establish "lead by example" programs to design and implement electrification projects and retrofit strategies in public facilities.	
Energy Modeling Methodology	**Modeling and Financial Assumptions**
This effect of this strategy is based on retrofitting a mid-sized municipal building. Assume that each township electrifies a similar building every four years through 2050. The effect on the energy mix is directly related to the fuel use replaced by electricity.	• Use the "1st Fire" building in West Chester Borough as the model for a mid-sized building. 1st Fire has approximately median gas and electricity use of all West Chester Borough buildings. • Assume that each township electrifies one similar sized building every four years. • Note that this results in a total of 48 municipal buildings being retrofit between 2020 and 2048 (one building retrofit per township every four years). • Assume the municipalities replace the entire existing heating system for 100% electrification. • Assume that the typical municipal building uses gas (boiler or furnace) for space heating and water heating (standalone system) and does not have central cooling (may have window units in offices). • Assume electrification of space heating to air source heat pumps (ASHP)/variable refrigerant flows (VRFs) and water heating through heat pump water heating. • Assume the 1st Fire building is 6500 square feet. • Assume heat pump water heater costs $6,000/unit (commercial scale 100 gallon) • Assume ASHP/VRF cost of $5,000/ton, which does not include heat recovery for simultaneous heating/cooling (30+% premium) • Heat pump technologies for heating/cooling are expected to be double or more of the cost of a baseline gas system. However, the incremental cost difference would be expected to be closer to 20-50% if the municipality were also planning on retrofitting buildings for central cooling. Given the age of some of municipal buildings, installation of ductless ASHP systems to provide cooling may be a driver for encouraging electrification of heating. • Pairing heating electrification with cost-effective energy efficiency retrofits (focused on building envelope improvements) can reduce the installed and operating cost of the systems. • Assume that buildings being electrified have heating systems

	that are at end of life to reduce stranded asset costs.

Appendix D. Energy Efficiency Strategies

Energy Efficiency

Although not a focus of this report, energy efficiency (EE) is a key first step in achieving RE targets as it reduces the overall amount of energy consumed at the economy-wide level. There are opportunities for efficiency improvements in all sectors of the economy that the WCA could consider pursuing. High-level guidance and resources on some key areas for EE advancement at the local level are summarized below:

Buildings

Buildings constitute a high proportion of energy usage in West Chester, as is true throughout the country. A selection of strategies for increasing efficiency (and associated resources) in both new and existing buildings are outlined in Table 1 below.

Table 1: Efficiency Strategies for New and Existing Buildings

Building Type	Potential Strategies	Resources

Building Type	Potential Strategies	Resources
New Buildings	**Building Energy Codes**: WCA can consider revising building codes to ensure the most stringent codes are adopted. These include: • For the **residential** sector, the 2015 International Energy Conservation Code (IECC) is already in place in Pennsylvania. The 2021 IECC is expected to be released later in 2020, at which time WCA can consider opportunities to align with the updated code.[29,30] • For the **commercial** sector, The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2016 **Code Compliance:** WCA can pursue a baseline study of EE, develop compliance goals, and continuously assess progress against goals. Pittsburgh is an example of a city that has dedicated staff to EE code compliance.	The US Department of Energy tracks state level commercial and residential adoption of building codes at the state level through quantitative progress on energy savings impacts. ACEE tracks code compliance by different cities that WCA may seek to connect with.
Existing Buildings	**Improvement Measures:** WCA can build on its benchmarking ordinance to include improvement measures, such as energy audits and retrofits/retro-commissioning projects. Energy audits identify potential for energy savings, and retro-commissioning projects implement the energy savings. **Benchmarking and Transparency Rules:** WCA can also consider encouraging or requiring buildings (or segments of building types) to publicly disclose consumption data.	American Council for an Energy Efficient Economy (ACEEE) Strategies for Energy Savings in Buildings. PECO provides various incentives for business customers as well as for its residential customers to support implementation of EE measures.

[29] Smart Energy International. January 2020. U.S. Local Governments Vote in Favour of New 2021 Buildings Efficiency Code. https://www.smart-energy.com/industry-sectors/business-finance-regulation/us-local-governments-vote-in-favour-of-new-2021-buildings-efficiency-code/

[30] New Buildings Institute. 2021 IECC national Model Energy Code. https://newbuildings.org/code_policy/2021-iecc-base-codes/

Future of Mobility

Reducing energy usage in the transportation sector will come through increasing mobility in a variety of less energy-intensive sectors, such as ridesharing, mass transit, and active transit, as outlined in Table 2.

Table 2: Transit Strategies

Transit Mode	Potential Strategies	Resources
Ridesharing	**Ridesharing:** Implementing ridesharing programs encourage people to travel together and to reduce traffic and travel costs. There are multiple avenues to pursue ridesharing, including WCA encouraging Employee Rideshare programs with financial incentives, or preferred parking spots for carpooling. Additionally, popular ridesharing apps such as Uber and Lyft can allow commuters traveling similar directions to carpool and thereby reduce traffic.	Shared Used Mobility Center overview of shared mobility
Mass Transit	**Bus routes:** WCA and SEPTA can devote resources and improvements to the bus systems, with ideas such as dedicated bus lanes and the use of HOV lanes. Employee passes and transit subsidies can be effective methods in encouraging greater mass transit use.	Alternative Fuels Data Center overview of mass transit
Active Transit	**Study viability of active transit** (e.g. walking, biking) **in select places and promote development where possible:** West Chester Borough is currently pursuing a potential Bike Lane Demonstration, and has conducted a Multimodal Traffic and Circulation Study with DVRPC. Participating municipalities could consider expanding on these initiatives to. Active transportation creates significant co-benefits such as healthier public spaces.	The U.S. Department of Transportation overview of Active Transportation

Additional Resources

Further details on the guidance in this section as well as additional resources for pursuing EE can be found at the below links.

Table 3: Energy Efficiency Resources

Resource	Description
American Council for an Energy Efficient Economy: Local Technical Assistance Toolkit	In addition to the buildings and electricity sector guidance, this toolkit also contains implementation support related to on EE in specific sectors and settings. Highlights include EE at lighting in public outdoor spaces, EE at wastewater treatment plants, increasing participation in utility EE programs and more. Of particular note is the Energy Efficiency Calculator that allows a user to evaluate the impact of potential EE actions in their locale.
American Council for an Energy Efficiency Economy: State and Local Policy Database	This database provides information on energy policies enacted by state and local governments across the US. These include policies for buildings and transportation sectors, as well as information on combined heat and power, utilities, and appliance standards.
American Council for an Energy Efficient Economy: Energy Efficiency Portals	This is a list of ACEEE's portals focused on energy efficiency. They cover state and local policies, but also programs in the commercial and industrial sectors.
State and Local Energy Efficiency Action Network (SEE Action)	SEE Action, a state and local-led effort, is facilitated by the US DOE and EPA. It builds off of the EPA's National Action Plan for Energy Efficiency, and provides resources and technical assistance to state and local policy makers who intend to focus on energy efficiency.

Appendix E. Solar Siting Analysis

Introduction

Cadmus generated an overview of nine preliminary solar photovoltaic (PV) array designs for multiple municipally-owned sites in the Townships of East Bradford, East Goshen, West Goshen, Westtown, and West Whiteland, and the Borough of West Chester, Pennsylvania. This memo details both the physical design and pertinent technical details at this stage of the project, such as estimated capacity, production, and performance, based on publicly available satellite images and site-specific information provided by the communities mentioned above. The estimated annual production offered in this analysis is used to project annual energy savings across all potential PV arrays. Finally, note that this analysis intends to support municipalities with decision-making regarding near-term solar developments. For this reason, the assumptions used in the analysis reflect current PV market conditions, and do not project potential future changes in the regulatory framework or available incentives.

Technical Specifications for the Proposed Solar Sites

This analysis was conducted using Helioscope,[31] a web-based PV design software, to generate a conceptual PV system design for each of the nine sites. For the models, Cadmus assumed industry standard LG 365W panels and Solectria or Enphase inverters depending upon the system's size. It is important to note that Cadmus did not try to maximize the total number of panels at each site, but instead aimed to design arrays that maximize solar efficiency and effective use of each space. Table 1 below displays a compiled list of all nine sites for which Cadmus designed arrays, as well as key system assumptions derived from the spatial design modeling exercise.

Table 1: Estimated PV Potential by Site

Township/Borough	Site Name	Location	Capacity (kW-DC)	Annual Solar Production (kWh)
East Bradford	Township Office	666 Copeland School Road	8.76	12,000
East Goshen	Public Works Annex	1570 Paoli Pike	78.8[32]	102,144
West Chester	Borough Hall	401 E Gay Street	178.1	247,100
West Goshen	Public Works Building	1025 Paoli Pike	145.6	197,200
	Wastewater Treatment Plant	848 S Concord Road	215.7	281,300
West Whiteland	House at Boot Road Park	110 W Boot Road	8.76	12,250
	Municipal Building	101 Commerce Drive	47.5	62,990
Westtown	Sewer Co. Inc.	950 Westtown Road	27.7	38,580

[31] Helioscope is a cloud-based solar photovoltaic design modeling software that integrates system design and performance modeling to develop preliminary layouts and energy yield calculations for measuring solar PV feasibility.

[32] Sized to onsite load, as detailed in Technical Analysis section

Township/Borough	Site Name	Location	Capacity (kW-DC)	Annual Solar Production (kWh)
	Pleasant Grove Pump Station	1147 S Concord Road	90.5 [33]	124,600

The total collective capacity of the sites as currently designed is estimated to total approximately 800 kW-DC, with a projected annual production potential of over 1,000 MWh. These projections take into consideration an average performance ratio of roughly 84%, which represents the total efficiency of a system considering electrical conversion, local weather patterns, shading, and typical panel degradation. The remaining assumptions we made surrounding PV in Pennsylvania are summarized in **Table 2**.

Table 2: Summary of Key Assumptions

Annual Utility Escalation Rate	1% [34]
Discount Rate	4%
Install Cost/Watt	$2.50 [35]
Annual O&M Cost/kW	$20.00
Annual Performance Degradation	0.5% [36]
Project Term Years	25
State Tax Rate	9.990% [37]
Federal Tax Credit in 2020	26% [38]
Value of SRECs in PA per MWh	$40.00 [39]
Retail Rate of Electricity per kWh	$0.057

Technical Analysis

The section below lists the findings of a site-by-site solar feasibility analysis. The analysis aims to provide decision-makers with support to better understand the extent to which solar development is technically and economically feasible. For each site, Cadmus provides a summary of key takeaways, including images representing potential PV array designs at each of the municipal sites and a table on the estimated PV potential. In the designs, each panel is represented by a single blue rectangle, while any orange zones have been identified as "keepouts" due to visible obstructions, standard setback restrictions, or necessary maintenance corridors. The financial details included in this section are calculated assuming the project is financed through a fixed price power purchase agreement (PPA) at a site-specific rate financially reasonable for a developer to pursue. Projected PPA savings figures are

[33] Sized to onsite load, as detailed in *Technical Analysis* section

[34] Cadmus assumed a conservative 1% annual utility escalation rate given recent market trends. However, if electricity prices rise at a faster rate, it will result in additional savings to the municipalities. https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf

[35] Average between PA residential and commercial install cost/Watt. https://www.energysage.com/solar-panels/solar-panel-cost/pa/

[36] https://financere.nrel.gov/finance/content/insights-pv-lcoe-through-new-degradation-study

[37] http://www.tax-rates.org/pennsylvania/corporate-income-tax

[38] https://seia.org/initiatives/solar-investment-tax-credit-itc

[39] SREC Trade in Pennsylvania. https://www.srectrade.com/markets/rps/srec/pennsylvania

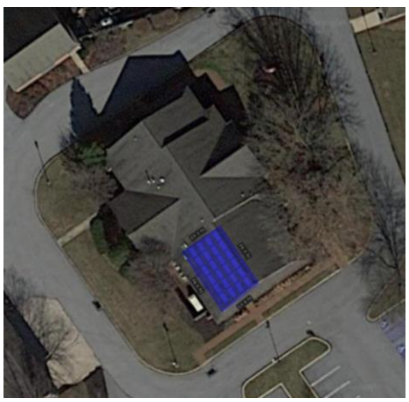
detailed in this section, as this financing option is most common for municipally owned properties. However, more details on power purchase agreements, direct purchasing, and incentives are explained in greater depth in the *Ownership Options and Incentives* section.

1. East Bradford Township Office

The East Bradford Township Office has limited roof space compatible with solar development given the unique roof shape and the presence of large trees over the northeast facing side of the roof. Despite this shading, the Township Office still has enough roof space to support an array of nearly 9 kW-DC capacity, with the potential to produce roughly 12,000 kWh of electricity annually. This generation is enough to offset approximately 29% of the current onsite electricity usage. Given the estimated production potential of an array at the Township Office, pursuing a PPA at this time will be less attractive until the value of SRECs and other incentives increase, or electricity rates rise.

Site 1. East Bradford Township Office Estimated PV Potential

DC Capacity (kW)	8.76
AC Capacity (kW)	6.96
No. Modules	24
Estimated Annual Production (kWh)	12,000
Percent of Current Electricity Load Offset	29%



2. East Goshen Public Works Annex

DC Capacity (kW)	78.8
AC Capacity (kW)	62.6
No. Modules	216

The southwest orientation of the East Goshen Public Works Annex makes it an excellent candidate for solar development. The Public Works Annex can support an array at least 78.8 kW-DC in size with the electricity generating potential of 102,144 kWh annually. The system's generation potential is enough to offset 100% of onsite electricity consumption, which currently costs East Goshen $7,527 each year. Given the estimated production potential of an array at the Public Works Annex, pursuing a PPA at this time will be less attractive until the value of SRECs and other incentives increase, or electricity rates rise. It is important to note that this system was scaled to onsite load. If solar incentives do improve, further development may be financially viable in the future.

Estimated Annual Production (kWh)	102,144
Percent of Current Electricity Load Offset	100%

Site 2. East Goshen Public Works Annex Estimated PV Potential

3. West Chester Borough Hall

Two of the three primary roof structures at the West Chester Borough Hall site are optimal for a PV installation. The third roof space seems a less-likely candidate for a developer to pursue development atop due to its dimensions and visible obstructions. However, the parking lot offers West Chester Borough the opportunity to install a solar carport, which could produce roughly 160,000 kWh annually, while simultaneously providing other benefits like shading in the summer and snow cover during winter months. As designed, the roof-mounted arrays could likely support an additional 60 kW-DC of PV, as they are positioned well for clean energy generation. The arrays modeled below have the potential to offset about 75% of onsite electricity consumption, saving the municipality an estimated $1,600 each year.

DC Capacity (kW)	178.1
AC Capacity (kW)	141.5
No. Modules	488
Estimated Annual Production (kWh)	247,100

Site 3. West Chester Borough Hall Estimated PV

4. West Goshen Public Works Building

The West Goshen Public Works Building has the available roof space to support a 145.6 kW-DC solar installation. In total, the arrays designed on the three best positioned roof spaces could hold about 400 panels, enough to generate nearly 200,000 kWh of clean energy each year. The site currently consumes approximately 224,000 kWh of electricity annually, which could be reduced by approximately 88% if a PV installation of this magnitude is pursued. Currently, a PPA could save the municipality upwards of $920 each year over the lifetime of the system.

Site 4. West Goshen Public Works Building Estimated PV Potential

DC Capacity (kW)	145.6
AC Capacity (kW)	115.7
No. Modules	399
Estimated Annual Production (kWh)	197,200
Percent of Current Electricity Load Offset	88%

5. West Goshen Wastewater Treatment Plant

The West Goshen Wastewater Treatment Plant has enough space onsite to support two ground-mounted arrays. The array currently modeled at the top of the site plan is sized at 117 kW-DC, and the southwest array is estimated at about 100 kW-DC. This image appears to show the site during the winter months, when there is minimal shading from surrounding trees, so it is important to note that the generation capabilities of some panels currently included in the design may be compromised in the summer and excluded by a developer as a result. Fortunately, this would likely only impact a few panels, so the annual solar production estimate of roughly 280,000 kWh is within reason. This level of generation has the potential to offset 10% of the Plant's large electricity load, enough to save West Goshen about $265 each year under a PPA.

Site 5. West Goshen Wastewater Treatment Plant Estimated PV Potential

DC Capacity (kW)	215.7
AC Capacity (kW)	171.4
No. Modules	591
Estimated Annual Production (kWh)	281,300
Percent of Current Electricity Load Offset	10%

6. West Whiteland House at Boot Road Park

The small building at the center of West Whiteland Boot Road Park could likely support an 8.76 kW-DC roof-mounted array. This system would have the electricity generating capacity to produce 12,250 kWh annually, which is 100% of the site's current consumption. Given the estimated production potential of an array atop the House at Boot Road Park, pursuing a PPA at this time will be less attractive until the value of SRECs and other incentives increase, or electricity rates rise.

Site 6. West Whiteland Boot Road Park Estimated PV Potential

DC Capacity (kW)	8.76
AC Capacity (kW)	6.96
No. Modules	24
Estimated Annual Production (kWh)	12,250
Percent of Current Electricity Load Offset	100%

7. West Whiteland Municipal Building

The flat roof space at the West Whiteland Municipal Building could support two arrays, with one installed on each of the two buildings depicted. Though moderate in size, the simplicity of the design and lack of roof obstructions leave few barriers to an installation at the location. A developer would likely be able to install 47.5 kW-DC of PV, capable of producing over 60,000 kWh of electricity annually. This electricity production would offset roughly 9% of the site's current 682,000 kWh annual electricity load. However, pursuing a PPA at this time will be less attractive due to the current incentives available and low electricity rates.

Site 7. West Whiteland Municipal Building Estimated PV Potential

DC Capacity (kW)	47.5

AC Capacity (kW)	37.7
No. Modules	130
Estimated Annual Production (kWh)	62,470
Percent of Current Electricity Load Offset	9%

8. Westtown Sewer Co. Inc.

The Westtown Township Sewer Co. Inc. is a relatively small site with significant tree cover, as shown in the image below. Despite visible shading, it is possible a small ground-mounted system could be successful at the southern edge of the property, though a developer would have to ensure the facility's tanks and surrounding trees would not significantly shade the panels. If the system could exist as currently designed, it would generate 38,850 kWh of electricity annually. This 6% electricity offset at a site that uses upwards of 650,000 kWh of electricity each year is not enough to save Westtown significantly on an annual basis under a PPA until incentives or electricity rates change.

Site 8. Westtown Township Sewer Co. Inc. Estimated PV Potential

DC Capacity (kW)	27.7
AC Capacity (kW)	22.0
No. Modules	76
Estimated Annual Production (kWh)	38,580
Percent of Current Electricity Load Offset	6%

9. Westtown Pleasant Grove Pump Station

The 18-acre open space at Westtown Township's Pleasant Grove Pump Station is capable of supporting a large ground-mounted array with a capacity over 700 kW-DC. However, developing a site of this size would involve high upfront costs. Moreover, the land appears to be neighboring both a residential area and possibly wetlands, which are often accompanied by development restrictions regarding zoning and permitting, which a developer would have to navigate. As such, Cadmus has provided two analyses. The first shows the theoretical potential of the large site as modeled in **Figure A**. In this case, the system would generate almost 1,000 MWh annually, nearly 800% of the Station's current onsite load. Based on this analysis, the Station could be a potential candidate for a community solar project. Separately, as an example that would help the municipality meet its current load while avoiding navigating land development restrictions, PECO net metering regulations, and potential limits to available funding, Cadmus also modeled a system at the site capped at 100% of the 124,600 kWh onsite load. This smaller system, represented in **Figure B**, will meet regulatory and zoning requirements and come in at a fraction of the cost. The projections associated with **Figure B were used for all financial projections, as this system faces fewer barriers to entry.**

Figure A: Solar PV Potential

Site 9A. Westtown Township Pleasant Grove Pump Station Estimated PV Potential

DC Capacity (kW)	719.4
AC Capacity (kW)	571.9
No. Modules	1,971
Estimated Annual Production (kWh)	984,000
Percent of Current Electricity Load Offset	790%

Site 9B. Westtown Township Pleasant Grove Pump Station PV Scaled to Onsite Usage

DC Capacity (kW)	90.5

AC Capacity (kW)	71.9
No. Modules	248
Estimated Annual Production (kWh)	124,600
Percent of Current Electricity Load Offset	100%

Figure B: Solar PV Scaled to Onsite Usage

Ownership Options and Incentives

Given that it is common for municipalities to opt for a PPA financing structure, this option has been used for the findings outlined in the section above. However, installing solar PV at the nine sites could be pursued through other mechanisms. The two most likely financing methods, direct purchase and PPA are outlined below, accompanied by savings breakdowns for each site and additional information on key solar incentives in Pennsylvania.

Direct Ownership

Purchasing the PV arrays directly would allow the municipality to accrue all the savings from the electricity generated onsite, while simultaneously maximizing the value of incentives available to public entities. If purchased directly, savings would be generated through:

- Collecting full value of electricity produced at each site, thereby offsetting a greater percentage of utility bills than possible under other financing methods
- Selling SRECS, which are accrued based on electricity production and currently sold at a rate of $40/MWh in Pennsylvania [40]. The value of SRECs in the state are projected to rise, as long as current legislative trends continue to benefit the Pennsylvania SREC market. For more information on the Pennsylvania SREC market, see Solar Siting Analysis Appendix.
- Net metering revenues when applicable.[41] This assumes each site will be able to net meter at the $0.057 retail rate of electricity specified by the municipalities.

Table 3 below represents savings estimates if the municipalities choose to purchase PV arrays directly, accounting for the estimated capital costs of installing a solar PV array in Pennsylvania. Cadmus assumed an install cost of $2.5/Watt and standard operations and management expenses for the purposes of this analysis.[42] The *25-Year Estimated Savings* column provides an estimate based on each site's annual electricity savings and the current value of SRECs. It should be noted that solar PV installations have repeatedly proven they benefit from economies of scale, with larger commercial systems in PA costing nearly $2.00/Watt and smaller residential systems costing over $3.00/Watt on average.

Table 3: Projected Savings Generated if Systems are Purchased Directly

Site Name	Annual Solar Production Potential (kWh)	Current Annual Electricity Usage (kWh)	Annual Electricity Usage Offset by Solar PV System	Annual Projected SREC Revenue	Annual Electricity Value Generated by Solar PV System [43]	25-Year Estimated Savings [44]
East Bradford Township Office	12,000	42,080	29%	$480	$994	$13,762
East Goshen Public Works Annex	102,144	102,144	100%	$4,085	$7,353	$81,842
West Chester Borough Hall	247,100	322,240	77%	$9,884	$16,879	$205,912
West Goshen Public Works Building	197,200	224,064	88%	$7,888	$19,281	$289,997
West Goshen Wastewater Treatment Plant	281,300	2,831,540	10%	$11,252	$19,058	$201,020
West Whiteland House at Boot Road Park	12,250	12,250	100%	$498	$858	$11,046
West Whiteland Municipal Building	62,990	692,400	9%	$2,520	$4,351	$48,777
Westtown Sewer Co. Inc.	38,580	653,952	6%	$1,543	$2,548	$30,392
Westtown Pleasant Grove	124,600	124,600	100%	$4,984	$10,437	$146,536

[40] SREC Trade in Pennsylvania. https://www.srectrade.com/markets/rps/srec/pennsylvania

[41] PECO. Net Metering. https://www.peco.com/SiteCollectionDocuments/January%201,%202016%20-%20Rate%20RS-2.pdf

[43] This value represents nominal dollars not real dollars, as it has not been adjusted for depreciation over time.

[44] This value represents nominal dollars not real dollars, as it has not been adjusted for depreciation over time.

Pump Station						

Power Purchase Agreement

A PPA is a contract between a private third-party developer and a property owner, the municipality in this case. Under a PPA, the developer installs, owns, and operates the PV system on the property at no cost to the property owner. Upon completion of the array installation, the third-party developer then serves as the electricity provider to the municipality. The PPA rate is often lower than what can be expected from the retail electric rate offered by the utility, though this is not always economically feasible for a developer. The lower rate (and municipal electricity savings) are created because the third-party financier is able to monetize:

- The Federal Investment Tax Credit, which will cover 26% of a PV system's cost in 2020
- SRECS, which are accrued based on electricity production and currently sold at a rate of $40/MWh, though projected to rise. For more information on the Pennsylvania SREC market, see Solar Siting Analysis Appendix.
- Net Metering revenues when applicable.[45]

Table 4 provides estimated PPA savings and the projected 25-year net value of installing PV at each of the nine locations, accounting for major incentives like the ITC and SRECs. Cadmus estimated a likely PPA rate for each of the nine sites based on what would produce a realistic and acceptable return on investment for a developer. The target return, or IRR, for the developer was set between 10%-11%, as this is likely the minimum threshold that must be met in order for a developer to consider pursuing a project. The target IRR value was used to estimate a feasible PPA rate, regardless of whether or not it resulted in a lucrative 25-year investment for the municipality. Under a PPA, the municipality realizes savings when the PPA rate they pay, coupled with the value of SRECs, falls below the utility rate they would otherwise pay the utility for electricity. For example, $0.09/kWh (PPA value) - $0.04/kWh (value of SRECs) = $0.05/kWh, which means the municipality will save approximately $0.007/kWh given their current electric utility rate of $0.057/kWh.

[45] PECO. Net Metering. https://www.peco.com/SiteCollectionDocuments/January%201,%202016%20-%20Rate%20RS-2.pdf

Table 4: Projected Savings Generated by the System Under a PPA

Site Name	Potential Solar Production (kWh)	Fixed $/kWh PPA Rate/Net Metering Credit Agreement [46]	25-Year Value of the PV Installation [47]
East Bradford Township Office	12,000	$0.076	-$5,371
East Goshen Public Works Annex	102,144	$0.060	-$7,218
West Chester Borough Hall	247,100	$0.050	$40,745
West Goshen Public Works Building	197,200	$0.052	$23,226
West Goshen Wastewater Treatment Plant	281,300	$0.056	$6,626
West Whiteland House at Boot Road Park	12,460	$0.070	-$3,816
West Whiteland Municipal Building	62,990	$0.058	-$1,484
Westtown Sewer Co. Inc.	38,580	$0.055	$1,818
Westtown Pump Station Open Space	124,600	$0.054	$10,272

Summary & Conclusion

Each of the nine sites highlighted by the participating municipalities are potential candidates for solar development, as each site can support a solar PV array capable of producing at least 12,000 kWh annually. **Each of the municipalities will have to decide which financing option is most suitable for its needs,** and the information provided in this memo can support the decision-making process. It can be informative to note that most municipalities around the country pursuing solar PV opt for a PPA given the value of the ITC and the added benefits of eliminating operations and management burdens. Additionally, it is uncommon for municipalities to have adequate funding to finance a significant investment like a large solar PV installation. However, given the value of SRECs and net metering regulations in Pennsylvania, it is difficult for developers to offer PPA rates lower than the current electric utility rates. Until in-state generation is made economically viable through higher SREC values, or electricity prices increase, purchasing solar PV systems directly will likely continue to generate significantly more savings over a 25-year timeline than available under a PPA, if funding is available.

[46] This value represents a rate assuming the developer is monetizing the value of the SRECs available.

[47] This value represents nominal dollars, not real dollars, as it has not been adjusted for depreciation over time.

Solar Siting Analysis Appendix: Pennsylvania SREC Market Background Information

Pennsylvania is one of 7 U.S. states that utilize Solar Renewable Energy Credits as a method of meeting their energy portfolio standards. The Pennsylvania Alternative Energy Portfolio Standard (AEPS) was established in part to incentivize the adoption of clean energy resources, setting minimum clean energy standards that electricity distribution companies (EDCs) and electric generation suppliers (EGS) must comply with or face a penalty.[48] The Pennsylvania AEPS currently requires 18% of the state's electricity supply to come from alternative energy sources, with a small carve-out specifically for solar generation.[49] One way EDCs and EGSs meet the state's solar RPS standards is through the purchasing of SRECs. One SREC is generated for every MWh of solar electricity produced by a PV system, which can then be sold on the SREC market.[50] The value of SRECs varies depending upon market supply and demand at any given time, but Cadmus' estimates in the *Annual Projected SREC Revenue* column in Table 3 and 4 assume a $40/MWh SREC value based on recent market trends.[51]

It should also be noted that recent and potential changes within the Pennsylvania SREC market will likely increase the value of SRECs in the state. First, the recently implemented *2017 Act 40* [52] minimizes the ability for out of state electricity generators to participate in the Pennsylvania SREC market. Previously, out of state electricity generator participation was high in the Pennsylvania the market, which drove down prices. Pennsylvania SRECs will likely increase in value as it becomes more difficult to purchase cheaper out of state SRECs. This more lucrative revenue stream produced from SRECs is expected to make in-state solar more economically viable. Additionally, the state has recently indicated it will likely implement further regulations that will only work to increase the value of SRECs moving forward, including aspirations to raise the standards defined in the state AEPS to incentivize more rapid adoption of solar technology and other renewables.[53]

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[48] NC Clean Energy Technology Center. DSIRE. Solar Alternative Energy Credits. https://programs.dsireusa.org/system/program/detail/5682

[49] EnergySage. SRECs in Pennsylvania: prices, projections, and program status. https://news.energysage.com/srecs-in-pennsylvania-prices-projections-and-program-status/

[50] SRECTrade. *Pennsylvania.* https://www.srectrade.com/markets/rps/srec/pennsylvania

[51] SRECTrade. *Pennsylvania*. https://www.srectrade.com/markets/rps/srec/pennsylvania

[52] Pennsylvania General Assembly. 2017 Act 40. https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2017&sessInd=0&act=40

[53] EnergySage. *SRECs in Pennsylvania: prices, projections, and program status*. https://news.energysage.com/srecs-in-pennsylvania-prices-projections-and-program-status/